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Russel H. Wyer, Director
Hazardous Site Control Division
Office of Emergency and Remedial Response
Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

RE: Proposed Addition of Pigeon Point Landfill To the National Priorities List

Dear Mr. Wyer:

This firm represents the Delaware Solid Waste Authority ("Authority"). On behalf of the Authority, I am hereby submitting its comments on the proposed addition of the Pigeon Point Landfill ("Pigeon Point") in New Castle County, Delaware, to the National Priorities List ("NPL") of hazardous waste sites.

In addition to this letter and the attachments submitted herewith, the Authority hereby adopts all other comments submitted to the Environmental Protection Agency ("EPA") in opposition to the aforesaid proposal.

This comment presents ample information and reason to dissuade the EPA from adding Pigeon Point to the NPL. However, the Authority hereby requests a hearing to allow amplification of the record and additional input to the EPA, if after reviewing this submittal the EPA is unconvinced that Pigeon Point does not belong on the NPL.

I. INTRODUCTION

The Authority is a statewide body politic and corporate constituting a public instrumentality of the State of Delaware, established under Title 7, Chapter 64 of the Delaware Code. One of the expressed purposes of the Authority's enabling legislation is "That a program for protecting the land, air, surface and ground water resources of the state from depletion and degradation caused by improper disposal of solid waste be established."[1] Indeed the first few words of the statute state that "the General Assembly finds and declares that the people of the state have the right to a clean and wholesome environment ..."[2] Throughout its twelve-year history, the Authority has deemed fundamental its responsibility to protect the resources of the state and the public's interest in them.

As part of the anti-degradation program, the Authority assumed management of Pigeon Point in January, 1981. Since then the Authority has operated the site as a fully licensed Resource Conservation and Recovery Act ("RCRA") landfill and spent millions of dollars to monitor and contain any possible threat posed by Pigeon Point. Such efforts have included the installation of a leachate collection system, use of effective operational procedures, arrangements for installation of a gas recovery system and establishment of a comprehensive monitoring network. In 1985 the landfill was closed after reaching the capacity specified in the permit in strict compliance with state regulations and federal regulations adopted under RCRA. Consequently, both the EPA and the Delaware Department of Natural Resources and Environmental Control ("DNREC") are well acquainted with the level of effort, expertise and expenditure undertaken by the Authority at Pigeon Point.

Pigeon Point is and will continue to be monitored closely. Currently the Authority utilizes 26 active observation wells at Pigeon Point which monitor numerous parameters quarterly, semi-annually, or annually. Both the number of wells and the number of parameters exceed the requirements in the Authority's DNREC permit.[3] As a result of the monitoring program, a large mass of data has been accumulated and a great deal is known about what is happening at Pigeon Point. Fortunately, the data convincingly demonstrates that Pigeon Point does not threaten the public or the environment.

Nonetheless, the EPA has proposed that Pigeon Point be added to the NPL. The NPL is an offspring of the Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §9601 et. seq. ("CERCLA"), as amended by the Superfund

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[1]7 Del. C. §6401(c).

[2]7 Del. C. §6401(a).

[3]Attachment 1, Pigeon Point Landfill, Delaware Solid Waste Authority (May 1987), p. 7.

Amendments and Reauthorization Act of 1986 ("SARA"). Section 105 of CERCLA requires the President to prepare a list of national priorities of hazardous waste sites. The President has delegated this responsibility to the EPA which has promulgated the NPL to satisfy the requirement. The EPA, by regulation, has adopted a methodology -- the Hazard Ranking System ("HRS") -- which it applies to sites under consideration for addition to the NPL.[4]

The HRS score is supposed to reflect the potential for harm to humans or the environment from migration of a hazardous substance by routes involving groundwater, surface water, or air. It is a composite of the three possible contaminant migration routes. The score for each route is obtained by assigning numerical values, according to prescribed guidelines, to a set of factors that theoretically characterize the potential of the release to cause harm. Sites with HRS scores of 28.50 or above are placed on the NPL. To support the score, the EPA compiles a documentation record ("D.R.") which contains the data and other information relied upon and referred to in the HRS document.

Although at odds with any thoughtful evaluation of Pigeon Point, the Pigeon Point HRS score is shown as 37.93. The score is based solely upon alleged "observed releases" of contaminants from the facility to the groundwater. Whoever prepared the Pigeon Point HRS made obvious errors which call into question the accuracy of and the motivation for the score. Among other things, the Pigeon Point HRS and D.R: (1) omit a large portion of the available data base, thereby facilitating the "tunnel vision" data analysis; (2) rely heavily on sample data from wells measuring contaminants in leachate contained within the landfill, rather than the sample data from wells testing the groundwater outside the landfill; (3) utilize infinitesimal measurements (e.g. one part per billion) in violation of the legally mandated HRS methodology; (4) misstate the hydrology underlying Pigeon Point and draw erroneous conclusions therefrom; and (5) embrace two highly anomalous test results -- one for arsenic, the other for tetrachloroethylene (pce) -- which, when evaluated in the context of all the available data, mean nothing scientifically.

The anomalous arsenic test result is critical, without it the HRS score falls below the 28.5 required for the NPL. To accept the arsenic test result, the HRS must assume that arsenic could have appeared in higher concentrations in the groundwater

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[4]40 C.F.R. §300, App. A (1986).

beneath the landfill than it ever appeared inside the landfill; that it could have appeared one time in high concentrations in wells scattered around the landfill and then disappeared forever (the highest recorded arsenic result since March 1985 from the groundwater wells is less than four parts per billion); and that the groundwater could have flowed uphill (the anomalous data included results from an upgradient observation well).

In short, the anomalous arsenic data should have been thrown out. At a minimum, the EPA consultant who prepared the HRS should have made a few inquiries about the source of the data. The Authority has. Its findings are documented below and in the attachments which include two letters. One is from the director of the now defunct laboratory which produced the anomalous result. He says, among other things, "the results reported for the arsenic determination were obviously in error ..."[5] The second letter is from a highly qualified expert who has reviewed the laboratory worksheets which generated the data. He states, "I am absolutely convinced that the values reported for arsenic in 1985 were in error. In fact, apparently arsenic was never determined on these samples at all."[6]

Although the EPA consultant who prepared the HRS did not do his homework, it appears that he followed his marching orders. Through the Freedom of Information Act, the Authority has located two memoranda (attached and discussed below) in the EPA's Pigeon Point file (but not incorporated into the D.R.) which suggest that the EPA decided to add Pigeon Point to the NPL before the data was even reviewed. If so, the EPA's objectives and motivation bear scrutiny. Hopefully the EPA cares more about implementing the Congressional objective of identifying the worst hazardous waste sites than it does about taking credit for adding one more number to the list.

The Authority opposes the addition of Pigeon Point to the NPL because the site simply does not "pose substantial danger to the public health or environment" as contemplated by §105 of CERCLA. The Authority's concern stems from the adverse impacts which certainly would follow final listing. The significance of

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[5]Attachment 2, undated letter from [redacted] to Delaware Solid Waste Authority, received June 25, 1987. Mr. [redacted] resides in South Carolina and is not associated in any way with the Authority.

[6]Attachment 3, June 26, 1987 letter from [redacted] Ph.D., to Delaware Solid Waste Authority.

the NPL is well known to the EPA, as it is to anyone in Delaware familiar with the events at the Llangolyn Landfill, Wildcat Landfill or Tybouts Corner -- all NPL sites. The Tybouts Corner epitaph, for example, might read: "Millions for study, analysis, and litigation, but not one penny for constructive action." It would be unfair to blame the EPA for Tybouts Corner. What has happened there is not simple to understand or explain. It would not be unfair, however, to point out to the EPA in the clearest terms possible that it must make sure that sites which do not belong on the NPL are not put there. There are too many sites that are hazardous and do present dangers, and too few resources to clean them up. To unloose the bureaucratic juggernaut for patently deficient reasons would unfairly and irresponsibly burden the citizens of Delaware.

The impression is that the EPA's approach is to take this step in the CERCLA process too lightly. The attitude seems to be that once a site is put on the list, then the EPA will take a close look to determine whether there is a problem. A half million dollars or so later (not to mention substantial public confusion and alarm[7]) the EPA may be satisfied. In the case of Pigeon Point, the Authority has been placed in the peculiar position of being a partner with the EPA and DNREC for six years in an enterprise that culminated with a state-of-the-art facility at Pigeon Point, only to learn of the proposed NPL listing in the morning newspaper. The Authority is as keenly committed to protecting the public and the environment as the EPA or DNREC. If the EPA or DNREC believed or believes that Pigeon Point poses significant dangers, the Authority should have been or should be so apprised, and the three public instrumentalities should have taken or should take appropriate action. The facts, however, are that there is no such danger and that the EPA and DNREC have acted accordingly, i.e. done nothing.

The Authority is disappointed that the EPA did not see fit to review the consultant's work carefully or provide the Authority with an opportunity to respond to the consultant's analysis before proposing that Pigeon Point be added to the NPL. Nonetheless, the Authority is hopeful that the EPA now will afford the proposed listing the close consideration it demands.

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[7]Some of the potential effects of NPL listing are illustrated in Attachment 4, a March 2, 1987, Washington Post newspaper article reporting the stigma associated with NPL listing.

II. SITE INFORMATION

CERCLA regulations recognize that the "use of the HRS requires considerable information about the facility, its surroundings, the hazardous substances present, and the geological character of the area down to the aquifers that may be at risk."[8] The Pigeon Point HRS and accompanying D.R. do not reflect an adequate understanding of the relevant information.

To supplement the record and to provide the EPA with necessary information, the Authority has undertaken an in-house evaluation of existing analytical and quantitative data regarding Pigeon Point. The results are presented in Attachment 1 and highlighted below. In addition, the Authority asked Duffield Associates, Inc. ("Duffield"), consulting geotechnical engineers, to prepare a separate compilation and evaluation of the relevant data. Its report appears as Attachment 5. A second consultant, Cabe Associates, Inc. ("Cabe"), performed a third analysis, a treatability study, which appears as Attachment 6.

Attachments 1, 5 and 6 reflect a significant feature of the site information, namely that there is a great deal of it. It is doubtful if many (if any) of the sites already on the NPL have been monitored more closely. The Authority assumed operation of the Pigeon Point facility in January 1981 and has complied with the EPA/DNREC monitoring/reporting requirements ever since. Attachment 1 relates the history of the site, including the pre-Authority management period during which 22 observation wells were utilized at various times. The HRS incorrectly states that New Castle County managed the facility from 1968 to 1980. Actually the County assumed operation in July, 1971. The City of Wilmington operated it briefly before then.

Attachment 1 also explains the Pigeon Point monitoring and containment systems in detail. Several documents discuss the effectiveness of the containment systems.[9] These systems include an impervious 12 foot thick liner, composed of dredge

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[8] 40 C.F.R. §300, App. A §2.0 (1986).

[9] See Attachment 1 (pp. 22 and 23), Attachment 5 (p. 2) and the New Castle County comment on the proposed listing (pp. 2 and 3).

spoils, which underlies all the refuse deposited at the site.[10] The HRS does not attempt to explain how the contaminants could have permeated the liner. As discussed below, the data generated from monitoring wells on either side of the liner indicates that the contaminants have been contained.

The containment systems also include an intricate leachate collection system which was installed in segments from 1974 to 1985. A schematic representation of the system is provided in Drawing IV of Attachment 1. The leachate (water and other liquid filtered through material in the landfill) is collected in pipes and pumped for eventual discharge into the New Castle County sanitary sewer system where it is ultimately treated at the Wilmington Sewage Treatment Plant.

This comment need not recount the voluminous details of the joint EPA/DNREC/Authority effort to safeguard the public and environment from any threat posed by Pigeon Point. The containment and monitoring systems have been installed at great expense. Fortunately, they have served their purposes. The only fair conclusion that can be drawn from the wealth of available information is that the contaminants at Pigeon Point are contained.

Unfortunately, the HRS ignores that information. One of the ironies presented by the proposed listing is that for years the Authority has been collecting data to satisfy itself and the EPA that there is no problem; now the EPA, through its consultant who prepared the HRS, has neglected to examine much of the EPA-required data and has concluded that there is a problem. That conclusion, if finally adopted by the EPA, will lead inevitably to additional monitoring and more data. In all scientific probability that new data will establish what has already been established by the ignored data, namely that there never was a problem. In any event, no one can seriously doubt that the monitoring will continue, with or without NPL listing. The only questions are whether the EPA will have another site on the list to count towards its recently expanded statutory goal and whether the public will have to bear the exorbitant expense occasioned by NPL listing with nothing to show for it.

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[10]Attachment 1, p. 2.

III. HRS ANALYSIS

The HRS score is derived solely because of a perceived groundwater contamination problem, i.e. the facility presents no risk by surface water contamination, air contamination, fire, or explosion. The groundwater score is based in large part on the conclusion that there has been direct evidence of a release of "a substance of concern" from the facility to groundwater. Under the CERCLA regulations,

> "Direct evidence of a release must be analytical. If a contaminant is measured (regardless of frequency) in groundwater or in a well in the vicinity of the facility at a significantly (in terms of demonstrating that a release has occurred, not in terms of potential effects) higher level than the background level, then quantitative evidence exists and a release has been observed."[11] (parentheses in original)

It is critical to distinguish the legal and scientific meanings of the term "regardless of frequency." As pointed out elsewhere and below, the Pigeon Point HRS score would fall below the number required for NPL inclusion but for one laboratory test result (i.e. the proposed listing relies on a single perceived measurement of a contaminant in groundwater off the site). From a scientific viewpoint, the test result may represent a single measurement of an off-site contaminant. As such it has little or no scientific meaning when scientifically interpreted in conjunction with other data, i.e. the one measurement or test result is not validated and is therefore disregarded. It is an aberration, explicable in a dozen ways which demonstrate the fallibility of testing.

From a legal viewpoint, "regardless of frequency" means that a single measurement of an off-site contaminant suffices for purposes of documenting the release. However, the legal analysis necessarily draws on scientific analysis. What is required legally is that the measurement be validated. If scientific analysis concludes that the one measurement has no validity, legally the requirement of one measurement is not satisfied. If a test result indicates the presence of arsenic in groundwater, but the sampling equipment is contaminated, or the laboratory procedure is not followed, or the mathematical calculations are

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[11] 40 C.F.R. §300, App. A §3.1 (1986).

run incorrectly, the test result does not stand and the one measurement is invalidated.

In short, the importance of the regulatory language "regardless of frequency" comes into play only if the single measurement is valid. One valid measurement establishes that the contaminant is in the groundwater and it is unnecessary after that to show how often it appears in a particular place or places. However, from a scientific viewpoint one aberrant measurement, under some circumstances, may be so inconsistent with all the other measurements that it is judged invalid for that reason alone. The Pigeon Point HRS documents fail to disregard the aberrant data. The discussion below (Sections IV and V) highlights the scientific analysis detailed in the attachments which concludes that the aberrant data is invalid.

Although misplaced reliance on the aberrant data is the most significant failing, other shortcomings reflect the superficial nature of the Pigeon Point HRS analysis. The New Castle County March 23, 1987, comment correctly criticizes the HRS for neglecting to (1) explain how the contaminants "apparently migrating through the dredge spoils" permeated the liner which far exceeds the EPA's standard for impermeable caps on sites closed with RCRA certification; (2) cite any data to establish background levels; (3) adequately consider the hydrology in the vicinity of the site; and (4) provide any factual basis for the numbers of people supposedly at risk because of Pigeon Point.

Attachment 1 illustrates how a thorough evaluation of the groundwater level data would have led the consultant to an accurate understanding of the groundwater flow patterns, and from there to an awareness that contaminants are not "apparently" migrating through the dredge spoils. Attachments 1, 5, and 6 consider the faulty HRS assumptions about the well gradients and the erroneous conclusions drawn therefrom. Upgradient wells sample water flowing onto the site, downgradient wells sample water flowing from the site. The former may be used to establish "background levels" of contamination. For example, if an upgradient well indicates the presence of benzene in quantities of 150 parts per billion (ppb), a downgradient well sample of 150 ppb would suggest the contamination is not coming from the landfill because the background level is just as high. On the other hand, if the downgradient well sample measures benzene at 450 ppb, the background level (150 ppb) would suggest that there is additional contamination coming from the landfill.

The HRS misinterprets the hydrology and incorrectly identifies the gradients of various wells. It classifies well no. 31 as "upgradient," well nos. 26R and 29 as "side gradient," and well no. 28 as "downgradient."[12] The classifications are wrong[13] and lead to the erroneous conclusions detailed in the next sections.

The lack of any meaningful discussion flaws the HRS fundamentally. It is little more than a series of conclusary statements, each citing references in the D.R., often with little relevance, without any attempt to analyze the references or pull the material together in any cohesive way. In fact, the references frequently raise additional questions about the validity of the conclusions. For example, D.R. reference no. 4 under the subheading "Groundwater" (the reference is not paginated) states "the DNREC has monitored the affects (sic) of the landfill contaminating the adjacent production wells at ICI, Americas, Inc. no relationship was established." Although the EPA's Pigeon Point HRS file contains one of the supporting documents for this statement, it was not made part of the D.R.[14] The document, Attachment 7, reports the results of a DNREC study to determine whether there is a hydrological connection between the zone screened in Pigeon Point observation well no. 28 and ICI well no. 11. The study concludes there is not. A later DNREC review of the study (Attachment 8), also in the EPA's Pigeon Point HRS file and not made part of the D.R., agrees with the conclusion.

Nonetheless, at page six the HRS predicates its "distance to nearest well" analysis on the distance from Pigeon Point well no. 28 to ICI well no. 11.[15] Apparently the DNREC study was never

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[12]D.R., Reference 16.

[13]Attachment 5, p. 8.

[14]The document was obtained through the Freedom of Information Act.

[15]There is an inconsistency between the HRS which, at page 6, says the distance "is located ... as measured from MW no. 28 ... approximately 0.5 mile southwest of the site", and the D.R. reference (no. 20) cited by the HRS. The reference includes a map with a dotted line from I.C.I. well no. 11 to the <u>boundary of the site</u>. This line is labelled "Distance to nearest well." According

FOOTNOTE CONTINUED ON NEXT PAGE --

reviewed or considered. Had there been any effort to establish the hydrological connection between the wells, or review -- even cursorily -- the information available in the file, the pertinent documents would have surfaced.

The HRS score is computed by plugging values into a mathematical formula provided by the CERCLA regulations. The HRS assigns the wrong values and consequently calculates the wrong score. By correcting the values, the HRS score is lowered. For example, when the aberrant arsenic test result is disregarded, the HRS score is lowered from 37.93 to 25.95. The difference can be attributed to the lower matrix value for toxicity/persistence. Without arsenic the value is reduced from 18 to 12. The calculation follows:

Observed release[16]	= 45
Wastes characteristics	= 13
Targets	= 44

$45 \times 13 \times 44 = 25740$
$25740 \div 57330 \times 100 = 44.90$
$44.90 \div 1.73 = 25.95$

Under the CERCLA regulations, the 25.95 score is too low to include Pigeon Point on the NPL. However, it is much higher than it should be when the data is analyzed correctly. The next two sections demonstrate that the HRS fails to document <u>any</u> "observed release" of contaminants from the landfill.

IV. THE BENZENE/ETHYLBENZENE ANALYSES

The HRS claims that the Pigeon Point data "show elevated levels of arsenic, ethylbenzene, tetrachloroethylene (pce) and benzene. These contaminants migrated through the base of the

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to the reference, then, the distance between the I.C.I. well and the boundary (<u>not</u> Pigeon Point well no. 28) was used. The CERCLA regulations expressly prohibit using the boundary line. They say, "Distance to nearest well is measured from the hazardous substance (not the facility boundary) to the nearest well that draws water from the aquifer of concern." (parentheses in original). 40 C.F.R. §300, App. A. §3.5 (1986).

[16]As pointed out elsewhere, the data does not substantiate an "observed release." A release is assumed here for purposes of recalculating the HRS without the arsenic result.

landfill and, in time, to and through the Columbia and Potomac aquifers."[17] As indicated above, this conclusion underpins the proposed NPL listing. Although the consultant's superficial analysis which leads to this conclusion disappoints the Authority, more disturbing are the questions which the analyses pose about the motivation for the HRS score.

The HRS benzene and ethylbenzene analyses are addressed herein separately because the arsenic and pce "releases" are each supported by one (and only one) test result, whereas the HRS cites no data supporting a benzene or ethylbenzene "release". The March 23, 1987 New Castle County comment (pages 3 and 4), the Duffield report (Attachment 5, pages 3-5) and the Cabe report (Attachment 6, pages III-3 - III-6), all fault the HRS benzene/ethylbenezene analyses.

The problems are obvious. The data cited by the HRS follows:

> "The data summary shows benzene was initially detected in March 1984 in mid-site base well nos. 46 to 49. Later, in March 1985, it was detected in well nos. 27R and 28, Columbia and Potomac wells, respectively. ... Ethylbenzene was discovered in base well nos. 46 and 47 in March 1984.[18]

A review of the HRS "support document", D.R. Reference no. 16, reveals that significant levels of benzene and ethylbenzene were found only in the mid-site wells (46-49) which are placed within the landfill to monitor the leachate.[19] These wells are placed into the refuse fill, above the liner which protects the underlying aquifers. They monitor leachate quality and quantity within the landfill. The relatively significant levels of benzene and ethylbenzene in the mid-site wells strongly suggest that the containment systems are effectively preventing contaminant migration out of the landfill because the same relatively significant levels do not appear in the aquifers beneath the liner.

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[17]HRS, Documentation Records for Hazard Ranking System, p. 2.

[18]Id.

[19]See Attachment 1, p. 9 (Figure 1), for a profile of the Pigeon Point wells and what they measure.

The HRS claims that benzene "was detected in well nos. 27R and 28, Columbia and Potomac wells, respectively."[20] It fails to note that the levels "detected" were one part per billion (ppb) and 1.5 ppb, respectively. As Attachment 6 states at page III-5, "EPA's performance evaluation of experienced lab testing standard samples without sample interferences from other contaminants revealed an analytical detection failure of 10%-30% even in the test range of 5-20 ppb." To report a 1.5 ppb test result as a "release" ignores the limitations of the test equipment and procedure. Moreover, as Attachment 5 points out, well no. 28 is an upgradient well (not downgradient as stated in the HRS).[21] Thus the data from well no. 28 does not substantiate a release from Pigeon Point, but instead provides information about the quality of water flowing into the site.

The use of the 1 ppb and 1.5 ppb test results to document a release also disregards the legal requirement in the CERCLA regulations, quoted above, pertaining to the background level. To demonstrate a release, the contaminant must be measured "at a significantly ... higher level than the background level."[22] Although the regulations do not define "significantly higher level", the Authority's understanding based on information provided by the EPA, is that the measurement must be at least 2.7 times higher than the background level.[23] If the 1 ppb benzene measurement for the downgradient well no. 27R is used, the HRS must establish a background level of .37 ppb. It has not and, given the infinitesimal quantity, cannot.

The ethylbenzene analysis suffers from the same problems. The HRS concludes that this contaminant "apparently" is migrating through the liner, but cites only the March 1984 data from mid-site wells 46 and 47 which monitor leachate above the

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[20]Supra, note 17.

[21]Supra, note 13.

[22]Supra, note 11.

[23]2-27-87 conversation with Lorie Acker, EPA, Region III, Hazardous Waste Management Division.

liner.[24] All the other data for the period cited by the HRS in support of the score report results of less than 1 ppb.[25]

The benzene and ethylbenzene analyses pose serious questions about the motivation behind the HRS analysis. The consultant's misinterpretation of the data and the requirements in the regulation, which are brief and relatively straight-forward, is perplexing. It strikes the Authority as odd that with all the test results of all the parameters measured at all the wells over all the years, that the EPA would not require something more substantial than an one-time 1.5 ppb test result to demonstrate a problem at the facility. The impression is that the benzene and ethylbenzene "releases" are used in the HRS to bolster the flimsy pce and arsenic data (discussed in the next section). If so, the Authority wonders if the consultant's mission was to justify a decision made by the EPA to add Pigeon Point to the NPL before the study was even started. The EPA HRS file contains a September 10, 1985 memorandum (Attachment 9) chastising an early analysis. It says:

> "I was surprised to find out from [redacted] that he did not review the state files, making the judgment that the information contained in the EPA file was sufficient to score the site. Since the draft HRS does not support an observed release to ground water, I cannot accept the reasoning, and am therefore returning the package.
>
> I have reason to believe that Delaware files do contain groundwater monitoring data which show contamination to be site related. I therefore, again request that state files be reviewed and this critical information be included in the HRS documentation."

This memo raises several questions. One--if the HRS did not support a release to groundwater, why did the score reflect such a release? Two--what motivation did the field investigation team (FIT) regional project officer (RPO) have to report a high score without any supporting data? Three--why was the memo posed in terms of how to document an NPL score rather than to investigate the site objectively?

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[24] *Supra*, note 17.

[25] HRS, D.R., reference no. 16.

A later EPA memo (Attachment 10) points out numerous problems, including an important one which was never corrected, namely the use of the data measuring the leachate. The second page states:

> "Tox/persistence - I think we should use only those compounds found in wells, since samples taken from the leachate collection system should be considered contained."

As explained above and below, the final HRS relies heavily on the leachate data anyway, raising two more questions: (1) why was the data used when the EPA understood it represents contained samples? and (2) was it used because the EPA and its consultant later learned nothing significant was found in the aquifer wells, and they therefore decided they had nothing better?

If, as it appears, the HRS process is nothing more than an exercise to justify a pre-investigation determination by the EPA that it wants Pigeon Point on the NPL, the Authority suggests that the EPA re-examine its statutory mandate; consider the Authority's track record, the history of the site since the Authority has managed it, and the Authority's own legislative mandate to keep the site safe; and take a long look at what it hopes to accomplish by listing the site. The treatability study (Attachment 6) prepared by Cabe reaches an obvious conclusion, i.e. practically there is nothing more that can be done at the Pigeon Point site than what is being done right now to protect the public's interest. The Authority understands that the CERCLA procedure normally does not address remedial issues during the NPL listing process. To the extent that that approach makes any sense at all, it must assume that the listing process is so infallible that it selects only the worst sites and that they undoubtedly require remedial action. The Pigeon Point site is already under the close control of a public instrumentality which clearly has the motivation and means to safeguard the public and the environment. The Authority's Pigeon Point expenditure in money, time, effort and expertise is well-known to the EPA. Also well-known to all is CERCLA's raison d'etre. There are thousands of sites -- not managed, not contained, not monitored -- which do pose serious threats to the public and the environment, and which would much better utilize the EPA's limited resources. The purpose of the NPL process is to identify the sites which need the EPA's attention the most. Pigeon Point needs it the least.

V. THE PCE/ARSENIC ANALYSES

The HRS states that pce:

> "was found in Potomac well no. 28 and base well nos. 46 through 49 in March 1984. In September 1984, it was found in Columbia well nos. 27R and 25R and Potomac well no. 28. In March 1985, the compound was found only in hydraulic fill well no. 1R. ... Arsenic was found in base well nos. 46 to 49 in March 1984. In March 1985, arsenic was found in Potomac well nos. 28 and 29."[26]

Again the HRS cites data (from wells 46-49 and 1R) measuring contaminants contained within the landfill to document a "release". The September, 1984 test result is the only alleged measurement cited in the HRS of any significant level of pce outside the landfill. Likewise, the March, 1985 test result is the only alleged measurement of any significant level of arsenic outside the landfill. The issue is whether these one-time aberrant results are scientifically valid when evaluated in the context of all the inconsistent data.

There are numerous possibilities for test result errors, including contaminated equipment and human error. Even under the best laboratory conditions there is the possibility of contamination from other samples. For example, in a busy laboratory one arsenic sample containing arsenic may be boiling off at the same time that the beaker cover is lifted off a different sample. A draft can carry a particle of arsenic into the beaker, thereby skewing the test result. Such possibility and others require quality controls which generally prevent the reporting of anomalous results. In this example the test would be run again if out-of-line with previous results. Unfortunately, these results came from a laboratory whose quality controls had completely broken down when the data was reported.[27]

The Delaware regulatory program most concerned with valid test results is the one implemented by State drinking water

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[26]<u>Supra</u>, note 17.

[27]Section VI discusses the laboratory responsible for the test result.

regulations.[28] These regulations permit testing only by laboratories meeting rigid certification requirements. Despite elaborate efforts to guarantee the best possible test results, the regulations recognize testing fallibility by requiring 3 additional tests within 30 days whenever a single test indicates a problem.[29]

The HRS interpretation of the pce data is questioned in Attachments 1, 5, and 6. Attachment 5 criticizes the HRS characterizations of the gradients and, unlike the HRS, explains its reasoning. At page 8 it opines that well no. 28 is ungradient to the Pigeon Point site and reflects background conditions with respect to groundwater flowing onto the site. Although the Authority doubts the validity of the anomalous September, 1984 100 ppb test result from well no. 28, it should be used, if used at all, to establish the background level, not a release. The same can be said of the March, 1985 arsenic result from well no. 28 (alleged as 218 ppb).

The Duffield report explains the unlikelihood of the data as follows:

> "these peaks generally appear (or increase) and disappear (or decrease) simultaneously at the twelve (12) monitoring locations, including the the interior leachate wells and leachate collection system, without regard to relative well location or groundwater flow. Groundwater flow is slow, and it is unlikely that a contaminant could escape from the landfill, flow several hundred feet, appear simultaneously at essentially all monitoring locations, and then disappear without a subsequent trace."[30]

In short, the contaminants supposedly appeared at high levels in upgradient and downgradient wells simultaneously, then totally disappeared. Cabe also doubts the validity of the pce data

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[28]Adopted 5-14-71 by the Delaware State Board of Health under 16 Del. C. §122(3)(c), as revised 9-27-77 and 5-5-82.

[29]Section 22.611D.

[30]Attachment 5, pp. 4 and 5.

because of the absence in any of the monitoring wells of pce's "daughter compounds" which typically follow pce detection.[31]

The anomalous data has also been questioned because it indicates the presence of much higher levels of contaminants beneath the liner than have been found in years of testing inside the landfill. According to Attachment 1, "(Arsenic) concentrations reported in perimeter wells 28 and 29 ... (groundwater wells) for March 1985 by far exceed the highest concentration ever recorded, before or after March of 1985, in the base of the landfill or points of leachate collection."[32] The deduction which must follow acceptance of the anomalous data is that the groundwater threatens to contaminate the landfill, not vice versa.

As pointed out above, the HRS score would not be high enough to justify an NPL listing if the arsenic "release" is not established. Thus the benzene, ethylbenzene, and pce scores by themselves are irrelevant. Presumably arsenic carries such clout because it is rightfully assigned maximum values in the persistence and toxicity indices in the CERCLA regulations. The Authority is well aware that arsenic, in sufficient quantities, is dangerous. If the EPA believes that the Pigeon Point data reflects a release of arsenic and a danger to the public, why has it chosen not to notify the Authority? Apparently the draft HRS was circulated longer than one year before the EPA brought the data indirectly to the Authority's attention. The Authority learned about the proposed listing in a morning newspaper, more than a year after the draft HRS was finished.

The Authority's own lack of concern about the anomalous arsenic data is scientifically founded. Aside from all the foregoing reasons for doubting the data and aside from all the evidence suggesting that that Pigeon Point containment system is effectively preventing releases from the landfill into the groundwater, the Authority takes comfort from the arsenic results from wells testing the groundwater since the anomalous test result was reported. They follow in toto:

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[31]Attachment 6, pp. III-5 and III-6.

[32]Attachment 1, p. 23.

Wells	March 1986	March 1987
Columbia Sands		
No. 25R	Less than 2 ppb	Less than 4 ppb
No. 27R	Less than 2 ppb	Less than 4 ppb
Potomac Sands		
No. 26R	Less than 2 ppb	Less than 4 ppb
No. 28	Less than 2 ppb	Less than 4 ppb
No. 29	Less than 2 ppb	Less than 4 ppb
No. 31	Less than 2 ppb	Less than 4 ppb
No. 41A	2 ppb	Less than 4 ppb
No. 45	Less than 2 ppb	Less than 4 ppb[33]

One more highly significant reason for disregarding the aberrant test results is presented in the next section.

IV. BRANDT LABORATORIES

Inasmuch as the aberrant test results for pce in September, 1984 and arsenic in March 1985 are totally inconsistent with the rest of the data, the Authority has attempted to learn whether the laboratory which produced them could explain what happened. The findings, hardly surprising given the nature of the data, are alarming because they demonstrate how easily, and for what relatively inconsequential reasons, the NPL process and all it signifies can be unleashed. The long and the short of it is that the laboratory that reported the aberrant results was in shambles when the anomalous tests were purportedly performed and the results reported, particularly the arsenic test which took place when the laboratory was in the final throes of its dissolution.

Before turning to the details, a few comments about the Authority's responsibility for the data are in order. The Authority was required under the permit issued by DNREC to arrange for the field sampling and laboratory testing which generated the data. Brandt Associates, Inc. ("Brandt Labs") performed the laboratory testing for the Authority from 1981 until the laboratory was dissolved in 1985, not long after the aberrant data was submitted. It also took the field samples for

[33] Compiled from data reported to DNREC pursuant to the Authority's permit.

the anomalous arsenic test reported in May, 1985.[34] Based on the data received during the first few years and on the contact maintained with the laboratory, the Authority had no reason to suspect there would be any problems. When Brandt Labs was selected by the Authority it was considered the best laboratory in the state. For several obvious reasons the Authority was not in a position to meaningfully evaluate the capabilities of the laboratory during the relatively short period of its demise.

The Authority should not be faulted for omitting to scrutinize the aberrant data when it was first reported. Undoubtedly one assumption was that an isolated reporting event would not be accorded much weight if clearly contradicted by the mass of other data. Apparently DNREC and EPA operated under a similar assumption because neither acted on the test result for nearly two years. Presumably the threat of arsenic to what the Pigeon Point HRS claims is a water supply serving 135,000 people would have merited more attention had either enforcement agency believed the data had any significance.[35]

In any event, the issue is not what should have been done with the aberrant data, nor who was to blame for it. The issue is whether it has enough validity to justify an NPL listing. Recently several individuals associated with Brandt Labs during the relevant period have been interviewed to help measure the value of the data. They uniformly and unequivocally assert that the arsenic data is untrustworthy. They also cast serious doubt on the validity of the aberrant pce result. From the founder and president of the company, Karl Brandt, down to the technician whose initials appear on the fateful arsenic data worksheet which "supports" the figures reported, they condemn the data. Attached is a list of names and phone numbers of everyone interviewed.[36]

This story emerges. The laboratory fell on hard financial times and was unable to meet its payroll consistently or maintain its equipment; it encountered serious morale problems and was unable to keep up with the workload; it lost the employee qualified to run the arsenic analysis, and ultimately failed to follow the laboratory procedures which give the test results any

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[34] 5-5-87 conversation with "non responsive based on revised scope" [redacted] Brandt Labs' director for part of early 1985.

[35] *Supra*, note 17, at 6.

[36] Attachment 11.

meaning. Representative remarks, all provided herein by permission, include statements that at relevant times (1) the people running the tests were not qualified, were improperly trained, and were under a great deal of stress;[37] (2) "things" degenerated rapidly, employees were not paid regularly, there were lots of problems, many personnel changes were made in the summer/fall of 1984, people were new to equipment and procedures, it was a period of "general upheaval";[38] (3) the lab was having difficulties with arsenic, it "pushed" work through and may not have followed procedures;[39] (4) the lab was "definitely falling apart," and "in a state of turmoil" in March, 1985, and with a constant state of flux in terms of how things were getting done;[40] and (5) test results at the lab in late 1984 indicated problems with pce, the laboratory was disorganized and messy, and industries using Brandt Labs were complaining about bad data.[41] The Authority contacted only one such industry, Georgia Gulf Corporation, and learned from its laboratory manager that the Brandt Labs data during the late 1984 - early 1985 period became erratic "with white-out all over everything."[42] Consequently, Georgia Gulf terminated Brandt Lab's services in the spring of 1985 because of "a complete lack of confidence."[43]

Out of this milieu came the test report which raises the HRS score to NPL proportions. The test result was reported to the Authority on a form which is not part of the D.R. The form was prepared by a clerk/typist from worksheets supplied from Brandt Labs' technicians who ran the tests. The worksheets for the relevant period are in the possession of Karl Brandt, who took

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[37] 6-12-87 conversation with [redacted] Brandt Labs' service director.

[38] 4-30-80 conversation with [redacted], Brandt Labs' director for part of early 1985.

[39] *Supra*, note 34.

[40] 5-5-87 conversation with [redacted], Brandt Labs' technician.

[41] 4-14-87 conversation with [redacted] Brandt Labs' saleswoman.

[42] 6-9-87 conversation with [redacted] Georgia Gulf Corp. laboratory manager.

[43] *Id.*

them when he ended his association with the company in September, 1985. At the request of the Authority, Mr. Brandt reviewed the worksheets and has produced the one which apparently supported the reported test data. It appears as Attachment 12. He also produced an earlier arsenic test worksheet (Attachment 13) to illustrate how the worksheet at issue should have been filled in. He discusses them both in his letter (Attachment 2) and concludes that the worksheets reflect that the standard testing procedure was not followed for the test producing the aberrant data. In other words, the aberrant data is supported by an aberrant worksheet.

The worksheet is deficient in important respects. With regard to the arsenic result, it is not initialed by any technician. The initials [redacted] stand for [redacted], the technician who ran the selenium test and whose calculations for that test appear in the right hand column on the same worksheet. The initials [redacted] stand for [redacted] who recorded the worksheet numbers onto the form sent to the Authority. Mr. [redacted] has explained that he did not run the arsenic analysis.[44] He has stated that he believed [redacted] ran the arsenic tests during the period in question.[45] In turn, [redacted] has said that he did run arsenic tests during that period but that he initialed all the test results.[46] The bottom line is that no one now acknowledges running the test.

The worksheet also is not initialed by a supervisor, indicating that it was not reviewed and that the quality control procedures were not followed. The worksheet contains no response readings from the test machine, making it impossible to re-run the calculations -- which also do not appear on the worksheet. Finally, the worksheet contains a handwritten code, no. "265", used to identify the type of procedure purportedly followed. At Brandt Labs, "265" represented a technique utilizing a graphite furnace, equipment which was not functional at the time the test was supposedly run.[47] Considering these deficiencies (not

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[44]Attachment 14, 6-25-87 letter from [redacted] to Delaware Solid Waste Authority.

[45]6-1-87 conversation.

[46]6-8-87 conversation.

[47]Attachment 2.

present in the other arsenic data worksheets reviewed by Karl Brandt at the Authority's request), the morale problems, the pressure to push out the work and the anomalous nature of the result, a credible explanation of the numbers is that they were simply fudged. Mr. Brandt acknowledges in his letter that the data is no good.[48]

Whatever the explanation, the data clearly does not support the conclusion reached in the Pigeon Point HRS, namely that unacceptable levels of arsenic have migrated through the landfill into an underlying aquifer. Attachment 3 presents the findings of a qualified expert who reviewed the worksheets and the Brandt Labs procedures with Karl Brandt. He concludes that the aberrant data was in error and that the arsenic test apparently was not even run. In addition, like every other scientist who has carefully analyzed the aberrant Pigeon Point data in the context of the subsequent data, he does not accept the anomalous result. He says,

> "I have never encountered another landfill in which a metal appeared at high levels in both upgradient and down gradient wells for one monitoring period and then promptly disappear. I believe that the evidence clearly shows that arsenic was never determined on these 1985 samples from the wells surrounding the Pigeon Point landfill."[49]

Considering the circumstances at the time of the test, it should not take an expert to reach the same conclusion. However, to the extent that the EPA is not satisfied that the data is untrustworthy, the Authority requests that the EPA allow the record to be expanded further. The validity of the aberrant data is critical and ultimately a scientific question. Though the Authority is convinced that the record adequately refutes the validity of the data, a hearing would enable additional facts to be developed and provide the EPA with whatever proof it deems necessary.

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[48] Id.

[49] Attachment 3.

VII. CONCLUSION

In many cases EPA's review of comments submitted in response to proposed additions to the NPL may be unimportant relative to other stages in the CERCLA process. The review is required, in part, because in the exceptional case it is important. It provides an opportunity to prevent an extremely wasteful utilization of limited resources. The challenge presented to the EPA by this comment (and the EPA's review of the HRS) is to capitalize on this opportunity by recognizing that Pigeon Point is that exceptional case.

The comment and the attachments provide information previously unknown to the EPA. The calamitous situation at Brandt Labs led inevitably to some bad data, but the bad data need not and should not mislead the EPA to take action which certainly will divert the resources of the EPA and the Authority, possibly in battle over the listing itself.

The Pigeon Point facility is the exceptional case, not only because the record now demonstrates that the critical laboratory results are invalid, but also because the facility is already monitored and managed by a public instrumentality which has done and will continue to do all that can be done to protect the public and the environment. There are open dumps not watched or managed by anyone and not contained by any liner or leachate collection system which are not on the NPL. Such sites and others require the priority attention contemplated by CERCLA, Pigeon Point does not.

The Hazard Ranking System was misused in this case by the EPA's consultant. The analysis relies on infintesimal measurements, ignores the background level requirement, misinterprets the groundwater gradients and hydrology, and accepts data unacceptable to anyone applying basic analytic chemistry. As a result, the Pigeon Point HRS fails to serve the purpose intended by CERCLA. Accordingly, Pigeon Point should not be placed on the NPL.

Sincerely yours,

F. Michael Parkowski

F. Michael Parkowski

FMP:JWH:dgf
Enclosures

ATTACHMENT 1

PIGEON POINT LANDFILL

DELAWARE SOLID WASTE AUTHORITY

MAY 1987

TABLE OF CONTENTS

FIGURES

DRAWINGS

The Site:

The Pigeon Point Landfill is located in the Atlantic Coastal Plain, in New Castle County, Delaware. It is sitting along the Delaware River, north of the westbound span of the Delaware Memorial Bridge.

The total area of the landfill is approximately 185 acres. The City of Wilmington owns approximately 100 acres, the Delaware Solid Waste Authority (DSWA) owns about 40 acres and the remaining 45 acres are owned by the Delaware River and Bay Authority (DRBA).

Prior to 1968 the site was used by the Army Corps of Engineers as a disposal site for the dredge spoils removed from the Delaware and Christina Rivers. The average depth of dredge deposits under the refuse is estimated at 12 feet (1). The recent deposits are mainly fine grained silt sediments with the calculated permeability of $1X10^{-7}$ cm/sec(2).

The site was used for landfilling operations by the City of Wilmington from January 1971 to July 1971, and then by New Castle County from 1971 to the end of 1980. The DSWA carried out the landfilling operations at the site from January 1981 to its official final closure in October 1985. The total area under the landfill is estimated at 120+ acres. About four million tons of wastes were placed in the Pigeon Point Landfill by the end of 1980. Since then another two million tons of refuse were added by the DSWA. The thickness of refuse deposit over the site varies from 40 to 60 feet, as is shown in the Plan of Property and Physical Features, (Drawing I).

The Leachate Collection System

In anticipation of leachate generation, installation of a leachate management system was started in 1974. The system consisted of interior, southern half and eastern perimeter gravity flow leachate collection pipes, subsurface water basin, surface retention basin and east lift station (Drawings II and III). The existing ditches, with minor modifications, were used to place the pipelines. A four feet wide six inch thick layer of Delaware Select Type C was placed on the bottom of the ditch and covered with a nylon reinforced PVC liner. Six inch perforated collector pipes were placed on the liner and covered with one and one-half feet Delaware Crushed Stone No. 106. This layer was covered with at least two feet of Delaware Select Type C(3). The collection pipes were collecting the leachate and discharging their content into the subsurface basin. The surface retention basin was used for the surface runoff management.

In 1977 two observation wells were installed at the base of the landfill to evaluate leachate generation*. A water level of

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*These are TB35 and TB36 with the following coordinates:

	Sur. Ele., ft.	Coordinates North	Coordinates East
TB35	34.04	3300	3660
TB36	34.34	3180	2880

approximately four feet above the base of the landfill was observed, which was an indication that leachate was being generated. Pumping started in June of 1977 to recycle leachate onto the landfill. The leachate recycling operation was an interim measure and a force main transmission line was built in 1980. The subsurface water basin was transformed to the present east collection manhole and pump station. The pumping of the collected leachate through the force main to the Wilmington Sewage Treatment Plant was started in late 1980.

The DSWA started operation of the facility on January 1, 1981. The west-side collection system was installed in April 1982. A small load facility collection system was completed at the same time. The northeast leachate collection system was completed in March of 1984 and the present system was completed in March 1985. The collected leachate flows to several interconnected pumping facilities for eventual discharge to the New Castle County sanitary sewer system and is ultimately treated at the Wilmington Sewage Treatment Plant. The pumping facilities of the system include three pump stations and two lift stations. Drawing IV provides a schematic representation of the leachate collection system.

The Monitoring System

No attempt was made to monitor the quality and record the quantity of the generated leachate during the early stages of landfilling operations. Initial quantitative information on the generated leachate dates back to 1977.

The first Observation Well was installed in 1973 (OW 1, 1.5" dia.). This was followed by the installation of four wells in 1975 (24, 25, 26 and 27). In 1976 Observation Well 1 was replaced by OW 1R and four new wells were added (28, 29, 31 and 32). In 1980 twelve new wells were installed (1A, 28A, 29A, 31A 32A, 37, 37A, 39, 41, 41A, 42 and 42A). In 1981 three previously installed wells were replaced (25R, 26R and 27R). In 1982 five wells were installed, the first four at the base of the landfill (46, 47, 48, 49 and 50). In 1983 and 1985 four wells were installed (40, 45, 52 and 52A, respectively). At this time (1987) there are 26 active Observation Wells (all 4" in diameter) which are used for monitoring the water quality parameters and groundwater level elevation. Observation Wells 37 and 37A were destroyed during the construction of new facilities. They were replaced by Observation Wells 52 and 52A. Observation Well 50 originally was installed to monitor groundwater quality effects of "wick drain" installation for Authority's Transfer Station Project. It was abandoned because it conflicted with plans of construction(4). Observation Well 46 was lost due to differential settlement of the landfill. The location of monitoring wells/observation points is shown in Drawing V.

The Data:

Beginning in March 1980, samples were collected from the observation wells functional at the time, and analyzed for water quality parameters (Alkalinity, Chloride, pH, Ammonia, Nitrate, TKN, Iron, TSS, BOD and COD) for three consecutive quarters. From 1981 collection of information on metals (Ba, Ca, Cd, Cr, Mg, Mn, Hg, Ag and Zn), non-metals (As, Pb, and Se) and Organic Chemicals (Benzene, Chlorobenzene, Ethylbenzene, Methylene Chloride, Tetrachloroethylene, Toluene and Trichloroethylene) were added to the list. The collection of analytical information is continuing to date on a quarterly, semi-annual or annual basis, depending upon the parameter being monitored. Information on groundwater level elevation has been available on a quarterly basis since 1981. Data on the specific conductance of the samples are available from 1980. Recently, temperature was added to the list of the parameters observed quarterly.

The leachate quantitative data has been recorded since June 1982 for the East Pump Station. For the West Pump Station and Northwest Lift Station, the quantitative data are available since October 1983. Mechanical problems have created a small interruption in data collected at East Pump Station since July of 1986. Leachate qualitative data are available at five locations (East and West Collection Manholes, Southwest and Northwest Lift Stations and DRP Fire Pond) since 1980, or as of completion of the construction for each of the above stations.

Evaluation of the Data:

An extensive amount of information is available, on different water quality parameters, since 1980. Most of the information is collected to satisfy requirements stipulated in the DNREC operating permit. In addition, some wells which were not included in DNREC's list were sampled frequently (31A, 32,...). Furthermore, the list of monitored parameters was expanded to include those which were not required by the permit requirements.

There are two kinds of constraints in the evaluation of the analytical data. First, there is the missing data elements, within the matrix of collected data on a given constituent, which effects the "trend-analysis" of the information. Second, this is the reported "Less Than" values which influence the "comparative analysis" of the data. The questionable nature of the data reported for September 1984 to March of 1985, however, is the only source of inconsistency observed in the body of the data. This is exemplified by the sudden jump in the observed concentration; immediate non-detection of the same constituent in a few observation wells installed in different geological formation.

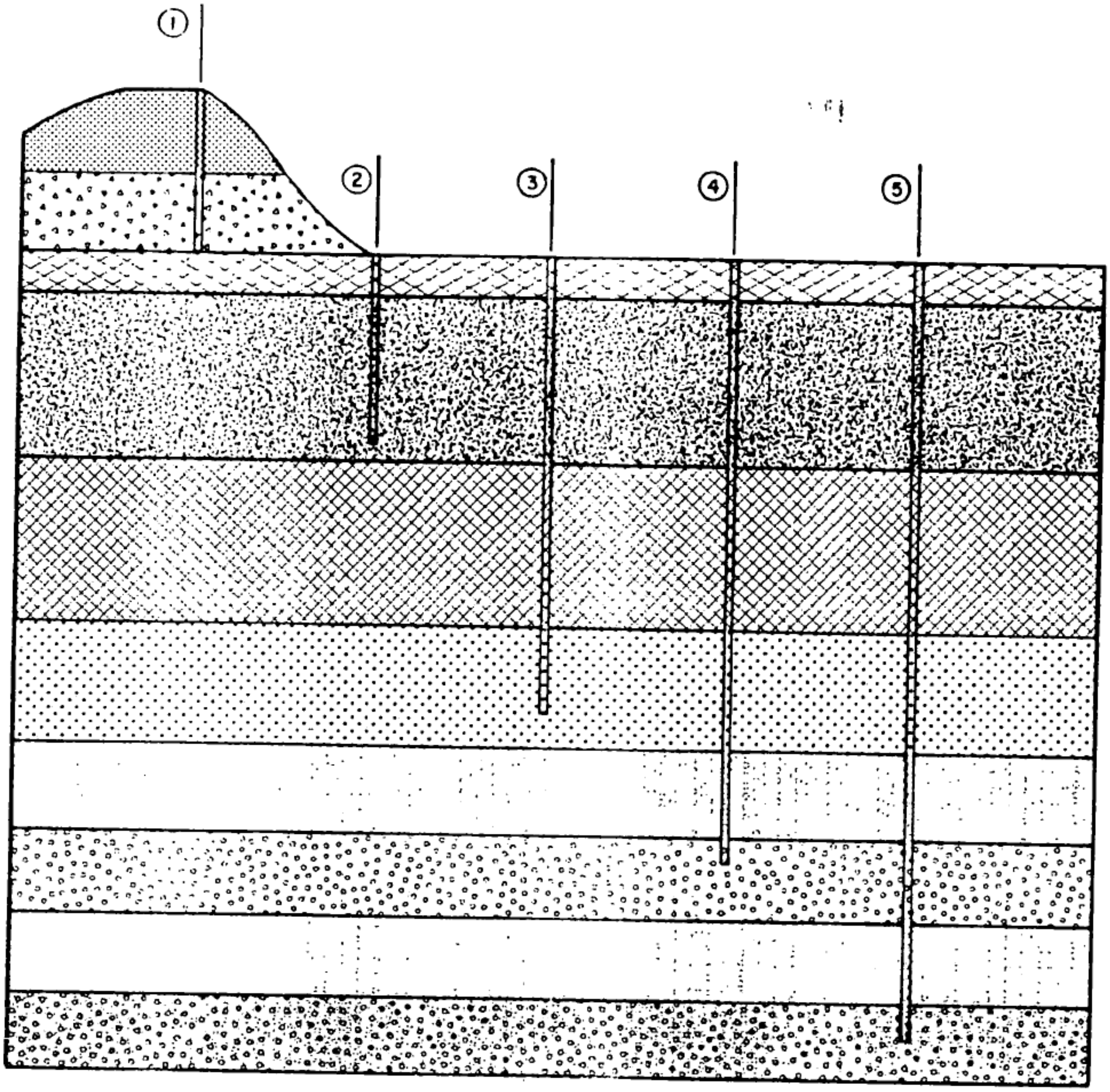
The groundwater level elevation data, on the other hand, provides a continuous spectrum of information amenable both to trend analysis and comparative analysis. It provides a solid base for the determination of the flow pattern, and thus the fate of the groundwater constituents based on historical data, for each of the aquifers. This is due to the fact that once a contaminant is in the aquifer, the primary source for its movement is created by the hydraulic gradient that produces groundwater flow. Contaminants entering the groundwater system are thus carried downgradient, forming a contaminant plume. Mechanical mixing and molecular diffusion cause the spreading of the contaminant over a much larger area and dilution of the contaminant away from the source area. Combination of all the elements discussed above, makes the analysis of the existing flow patterns of major importance.

Groundwater Flow Patterns at the Site:

Based on available geological information, a simplified hydrogeological profile of the Pigeon Point landfill is presented in Figure 1. This figure depicts monitoring wells and the aquifers in which they are installed. The analyses which follow are based on information provided on Figure 1 and historical groundwater level elevation data available on each well.

Base of the Landfill:

The historical water level elevations have been measured for the observation wells installed at the base of the landfill (46, 47, 48 and 49). This information indicates the existence of a leachate mound, as is depicted in Figure 2. The same data suggests northeasterly flows from Observation Wells 46 and 48 toward Observation Wells 47 and 49, respectively. Another flow pattern in southwesterly direction is observed from Observation Well 48 toward Observation Well 47, and from Observation Well 46 toward the southern leachate collection system, as is presented in Figure 3. The presence of the above two flow patterns is



(1) OBSERVATION WELLS 47, 48 AND 49
(2) OBSERVATION WELLS 1R, 28A, 29A, 31A, 32A, 39, 40, 41, 42 AND 52
(3) OBSERVATION WELLS 1A, 25R, 27R AND 50
(4) OBSERVATION WELLS 26R, 28, 29, 31 AND 41A
(5) OBSERVATION WELL 45

KEY:
- TRASH
- LEACHATE
- DREDGE SPOILS
- WATER TABLE AQUIFER
- RECENT DEPOSIT, FINE GRAIN SEDIMETS
- COLUMBIA AQUIFER, COLUMBIA SANDS
- POTOMAC, "SILT-CLAY"
- UPPER POTOMAC AQUIFER, POTOMAC "SAND"
- POTOMAC AQUIFER, POTOMAC "SAND"

NOTE:
WELLS GROUPED TOGETHER AS (2), (3), (4) AND (5) ARE PERIMETER WELLS AND DO NOT GO THROUGH REFUSE.

FIGURE 1. SIMPLIFIED HYDROGEOLOGICAL PROFILE, PIGEON POINT LANDFILL

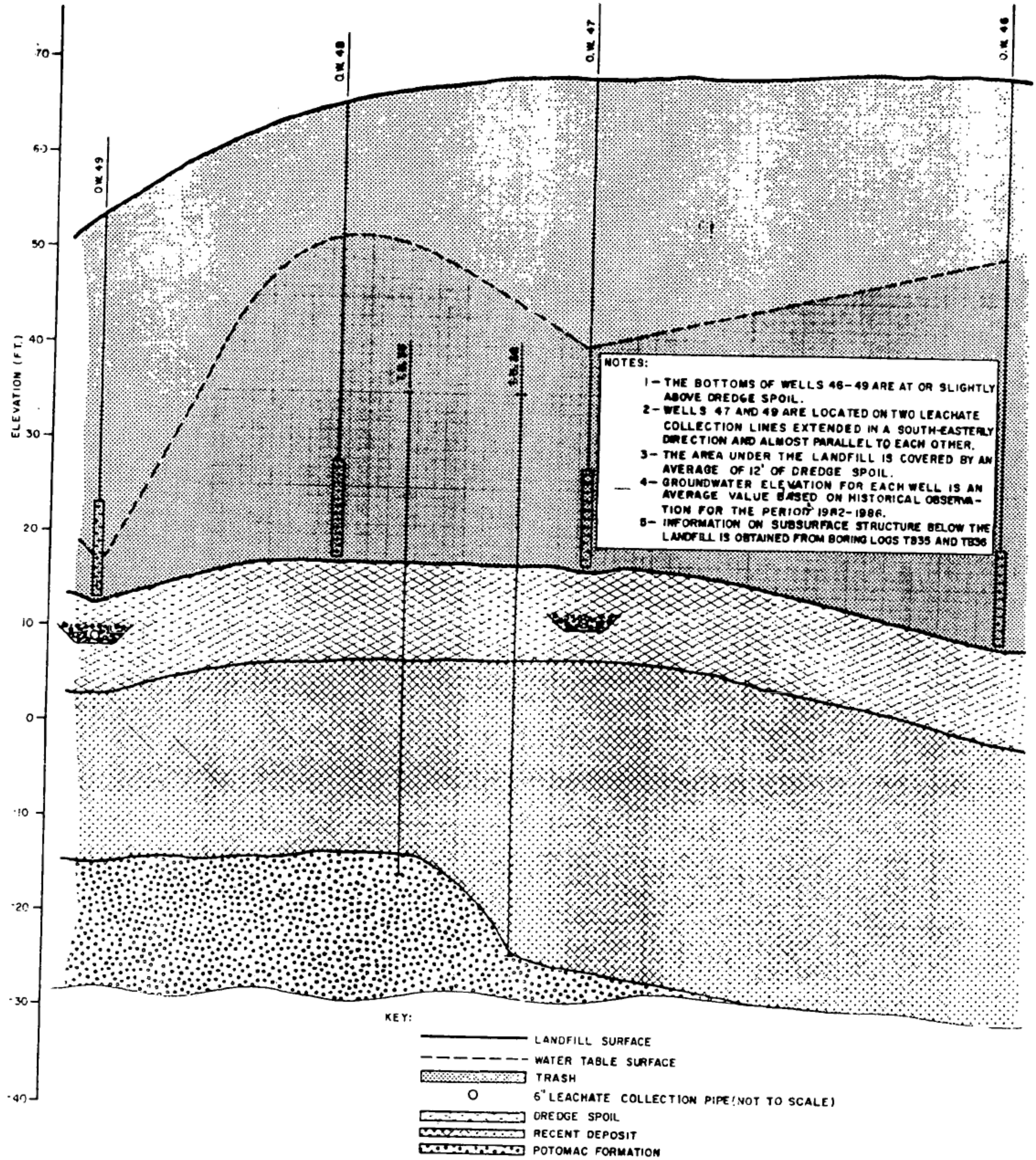


FIGURE 2: LEACHATE MOUND AND SUBSURFACE FORMATIONS PROFILE

dictated by the location of the two interior leachate collection pipelines, which are located under Observation Wells 47 and 49, respectively (Drawings IV and V). Another pattern of flow is expected to be present and that is an outward radial flow from the landfill toward the perimeter leachate collection system. The existence of this pattern, however, cannot be documented with the present rather linear arrangement for the location of the Observation Wells which runs almost parallel to the perimeter leachate collection pipe. No unexpected pattern of flow or unexplained presence of a sink within the base of the landfill was observed.

Recent Deposits - Dredge Spoils (Water Table):

An outward radial pattern of flow, centered at Observation Well 52, toward eastern, southern and southwestern boundaries of the site is observed. A sharp decline in historical average water level elevation is detected at Observation Well 41, as is shown in Figure 4. There are some possible suggestions to explain this historical average low elevation of water level. Among them are: (1) the presence of the Magazine-Ditch with an elevation of 2' or less for the bottom of the ditch, at the southern edge of the site, adjacent to Observation Well 41 (Drawing VI) which may act as a sink. (2) The relative shallowness of the underlying layer of recent deposit dredge spoils, as compared to the average depth of this layer present at other locations (Drawing VII). There is no evidence of the

FIGURE 3: HISTORICAL AVE. WATER LEVEL ELEV., FT., EXPECTED FLOW DIRECTION(S); BASE OF LANDFILL (1981–1987)

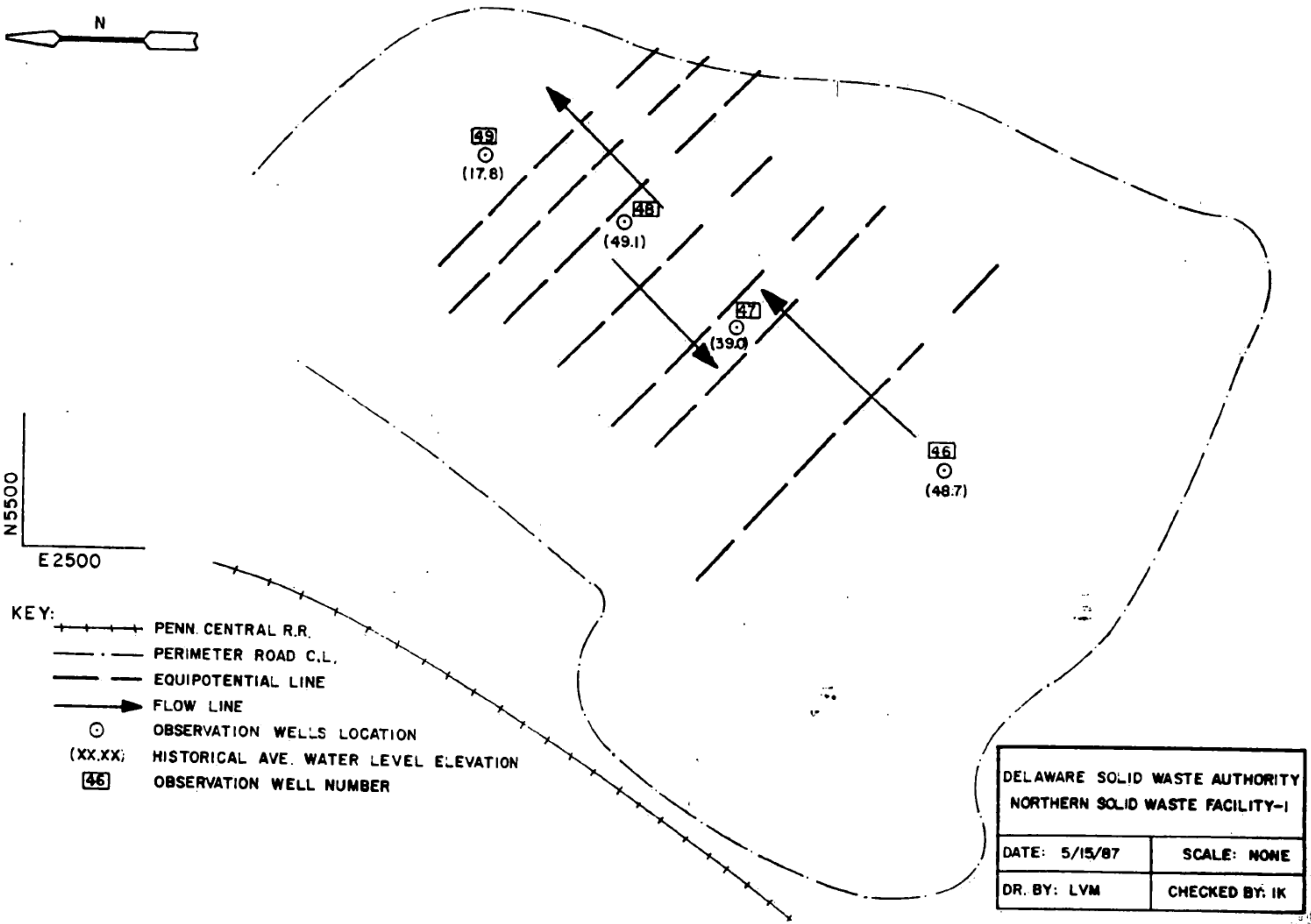
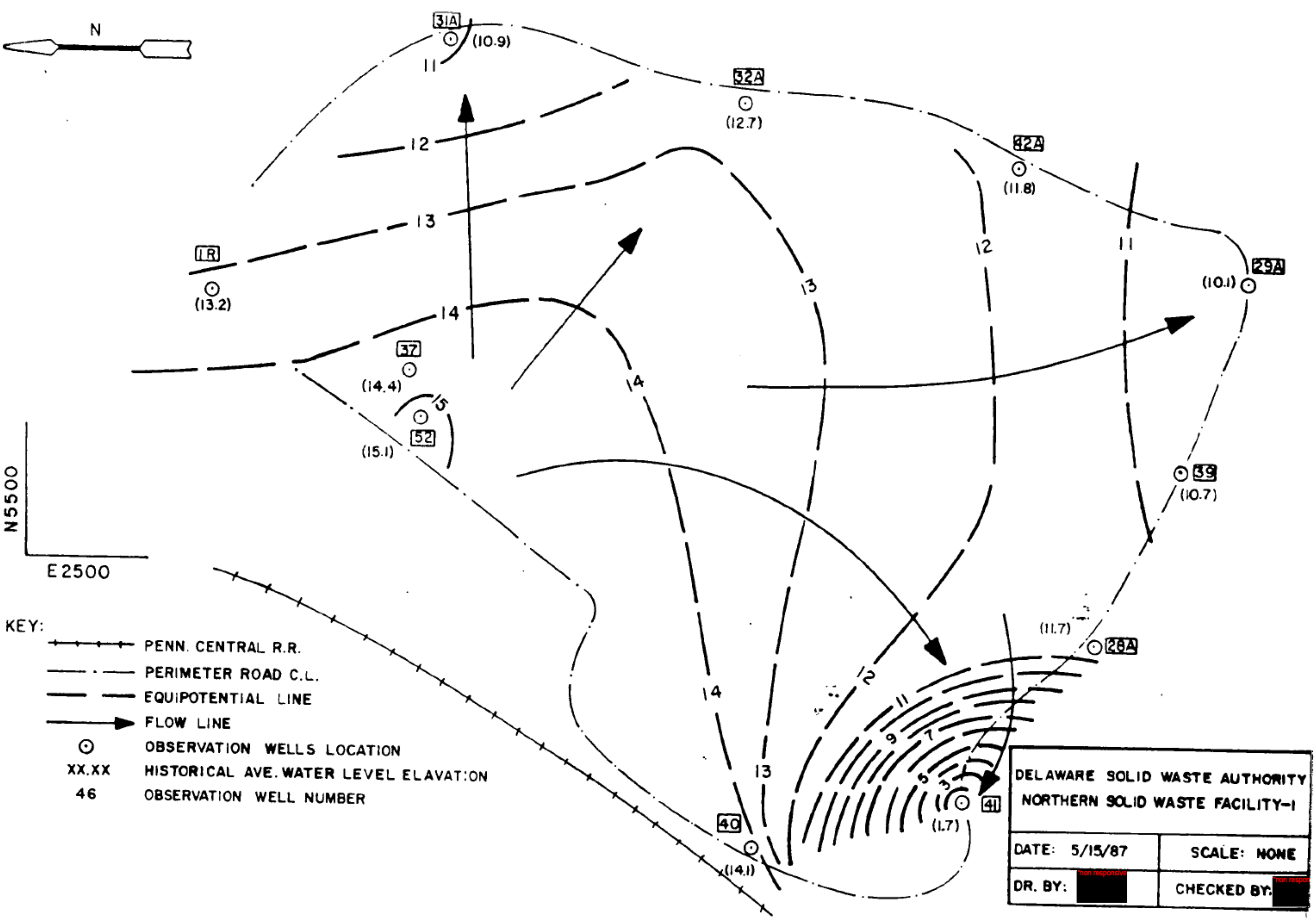


FIGURE 9: HISTORICAL AVE. WATER LEVEL ELEV., FT., EXPECTED FLOW DIRECTION(S); RECENT DEPOSITS–DREDGE SPOILS(WATER-TABLE) (1981-1987)



presence of a deeper "water table" around Observation Well 41. Therefore, the observed low average depth was considered as a part of the general water table surface, and its value was used in the development of the equipotential contours for this aquifer.

Recent Deposits - Basal Zones:

There are few factors which suggest that construction of equipotential contours for this zone may not be realistic. First, the average groundwater elevation level observed in Well 52A is almost 4' higher than the corresponding "water table" elevation, as indicated by Observation Well 52. The same phenomenon is observed in Observation Wells 37 and 37A (which were abandoned in 1985). This rise in groundwater elevation level is attributed to the "wick drain" installation for the nearby construction (6). These wicks are allowing water, being squeezed from the overlying compressible deposits, to drain into underlying sand stratum, resulting in the observed water level rise. This trend, however, is expected to reverse itself over a reasonable period of time. Second, the remaining three Observation Wells (24, 32 and 42A) are practically located along the same line, extending in a northern direction, from 42A to 24. Therefore, no flow pattern for this zone is determined.

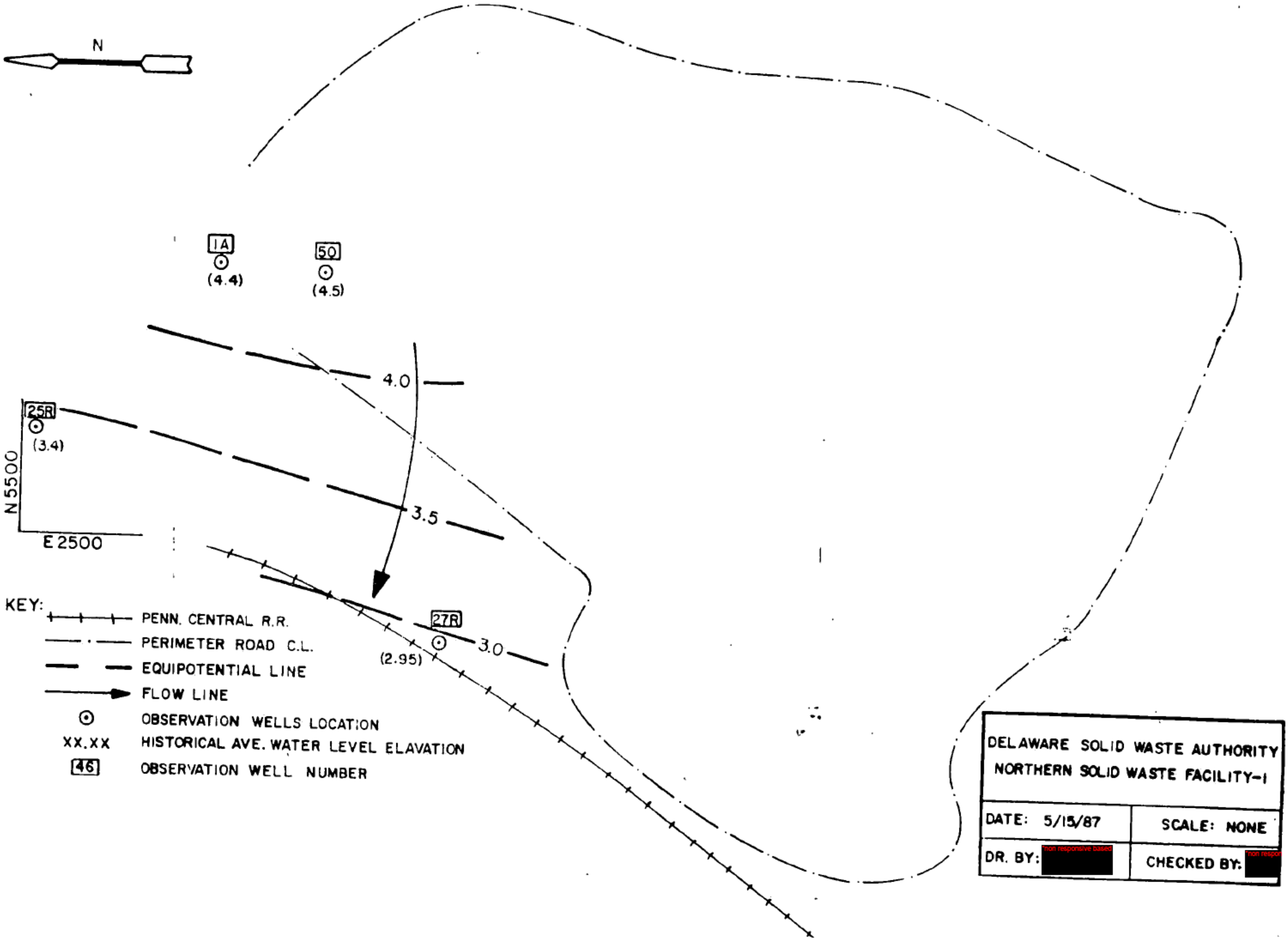
Columbia Sands:

Indications are that historically there is a flow pattern in the western direction, away from the landfill, in the northwestern portion of the site, as indicated in Figure 5. Boring logs' information suggests a continual presence of the Columbia Sands in the perimeter of the site, starting in a location north of Observation Well 42 and extending in a counterclockwise direction all the way to the south of Observation Well 27R (see Fence Diagram). Test borings drilled to the east of Observation Well 48(TB35) and in the west of observation well 47(TB36) did not indicate the existence (or extension) of the Columbia formation above the depths of -16' and -25' respectively. At these locations Potomac Sands were encountered immediately below the layer of recent deposits (See Figure 2).

Potomac Sands:

The present hydrogeological information may suggest the existence of two aquifers in the Potomac Sands. There are, however, obvious discontinuities present in the available geological information in the deeper strata at the southwest corner of the site to warrant further geological investigations. Long term analytical information on nonreactive constituents of groundwater is needed for prediction of the flow patterns in this formation. In the absence of such information, and with the exclusion of Observation Well 45 (which is considered as an observation well installed in the deeper Potomac formation) from the set of historical average water elevation level data, the

FIGURE 5: HISTORICAL AVE. WATER LEVEL ELEV., FT., EXPECTED FLOW DIRECTION(S) COLUMBIA SANDS (1981–1987)



flow pattern in this formation is presented in Figure 6. This figure depicts a flow pattern in the eastern direction, away from Observation Well 28 toward Observation Well 29, in a formation presently considered the upper Potomac Sands. It should be noted that the observed pattern may not represent a given seasonal observation. It will provide, however, a historically dominant flow pattern within this aquifer.

The Leachate:

The data collected in 1977 indicated an average generated volume of leachate equivalent to 39,000 gallons per day, for the first 90 days of operation(7). Data collected by the DSWA since 1981 does not indicate a regular pattern of seasonal fluctuation for any of the individual stations. The collected leachate from the landfill, for the period in which continuous records on all three stations are available, is depicted in Figure 7. This curve indicates a downward trend in the quantity of the leachate being generated. The precipitation data, for the same period, are presented in Figure 8. When precipitation data and the generated leachate data are plotted on the same chart, for the corresponding period of time, high quantity of generated leachate is observed to lag behind the higher level of precipitation (Figure 9). This trend, however, is not expected to continue after a reasonable period of time is passed from the operationally closure date of the landfill (January of 1986). It is expected that the leachate quantitative data continue its

FIGURE 6: HISTCRICAL AVE. WATER LEVEL ELEV., FT., EXPECTED FLOW DIRECTION(S) POTOMAC SANDS
(1981–1987)

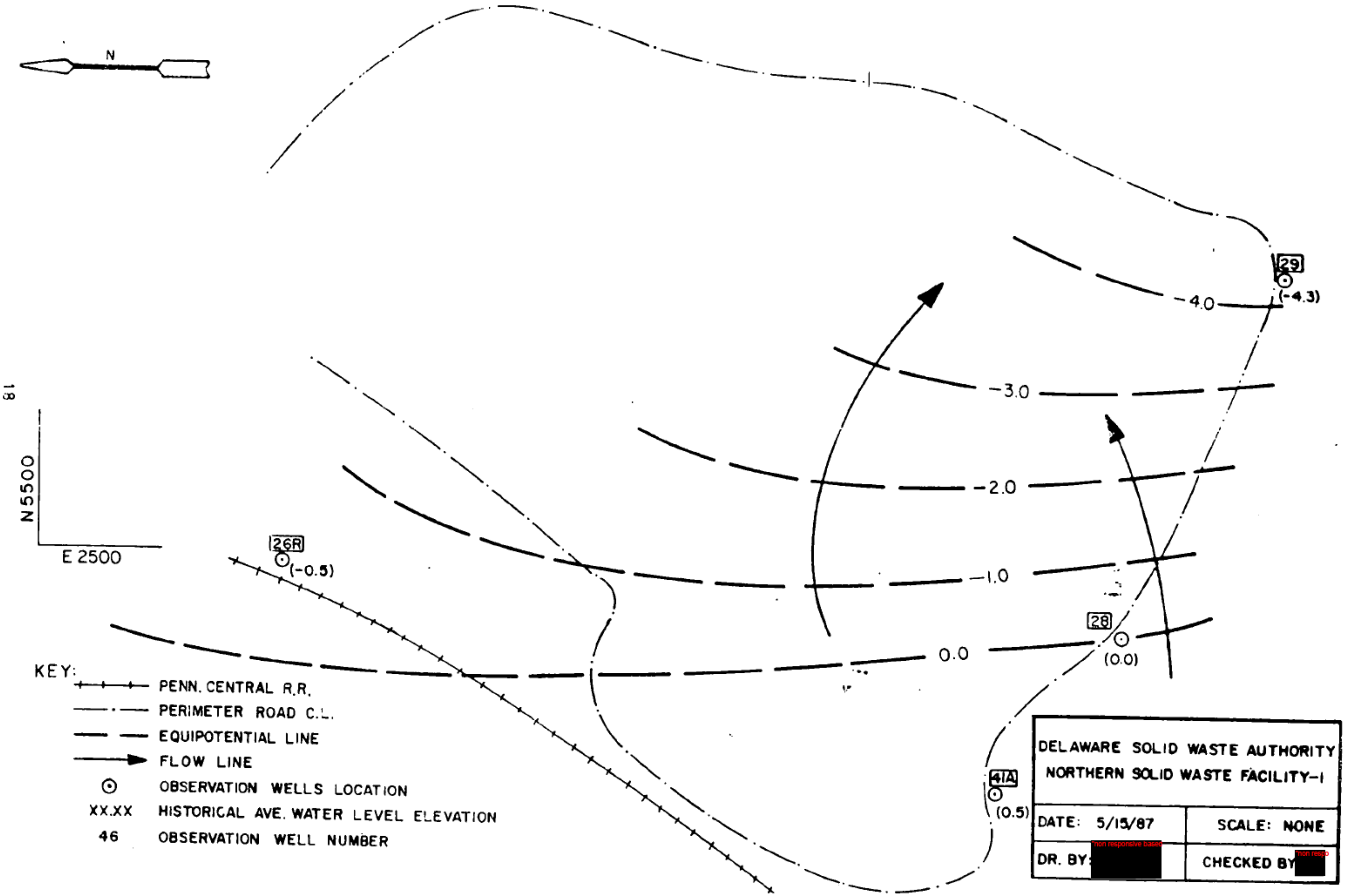


FIGURE 7:

HISTORICAL LEACHATE COLLECTION DATA

ALL STATIONS

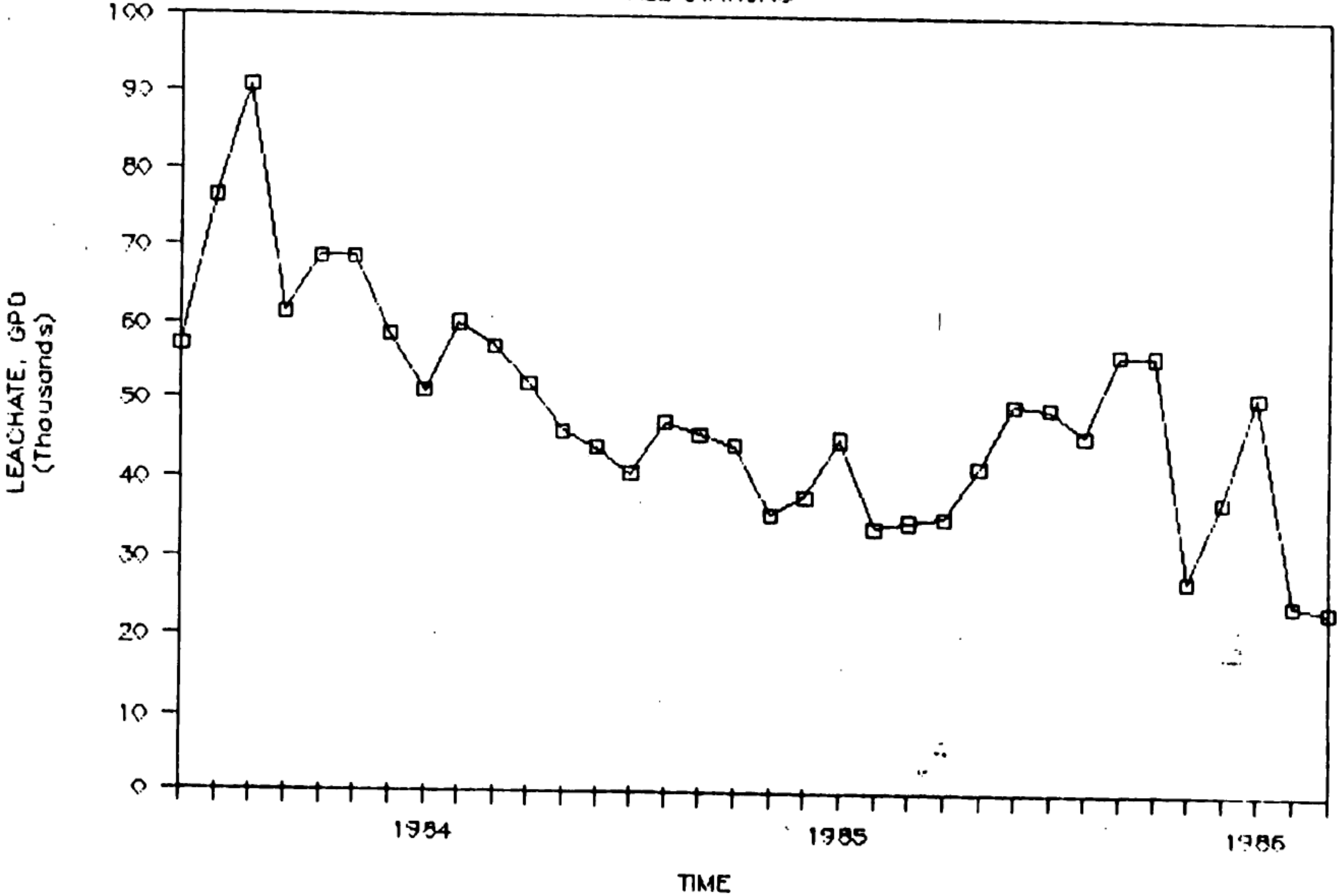


FIGURE 8:

HISTORICAL PRECIPITATION DATA

GREATER WILMINGTON AREA

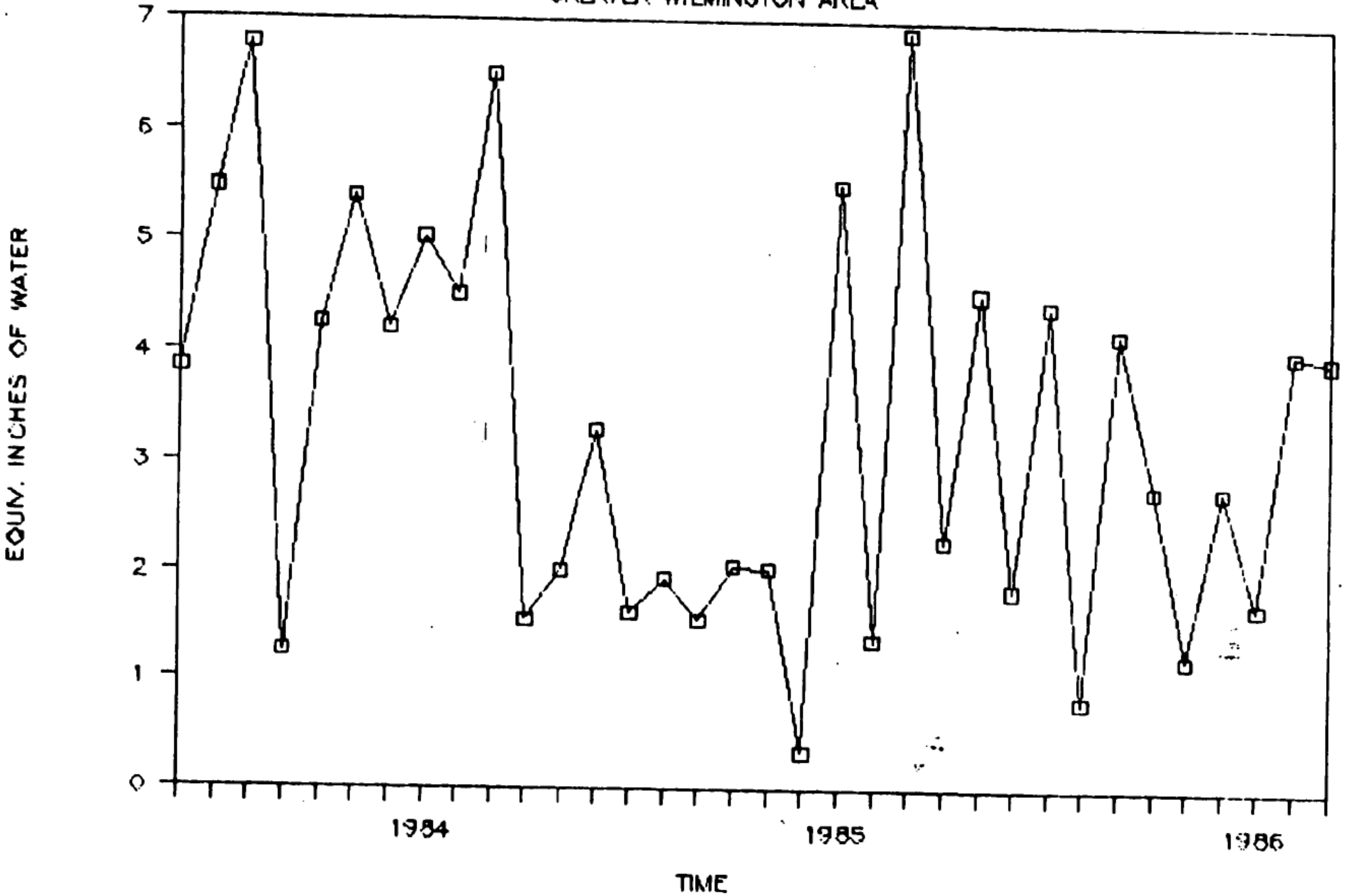
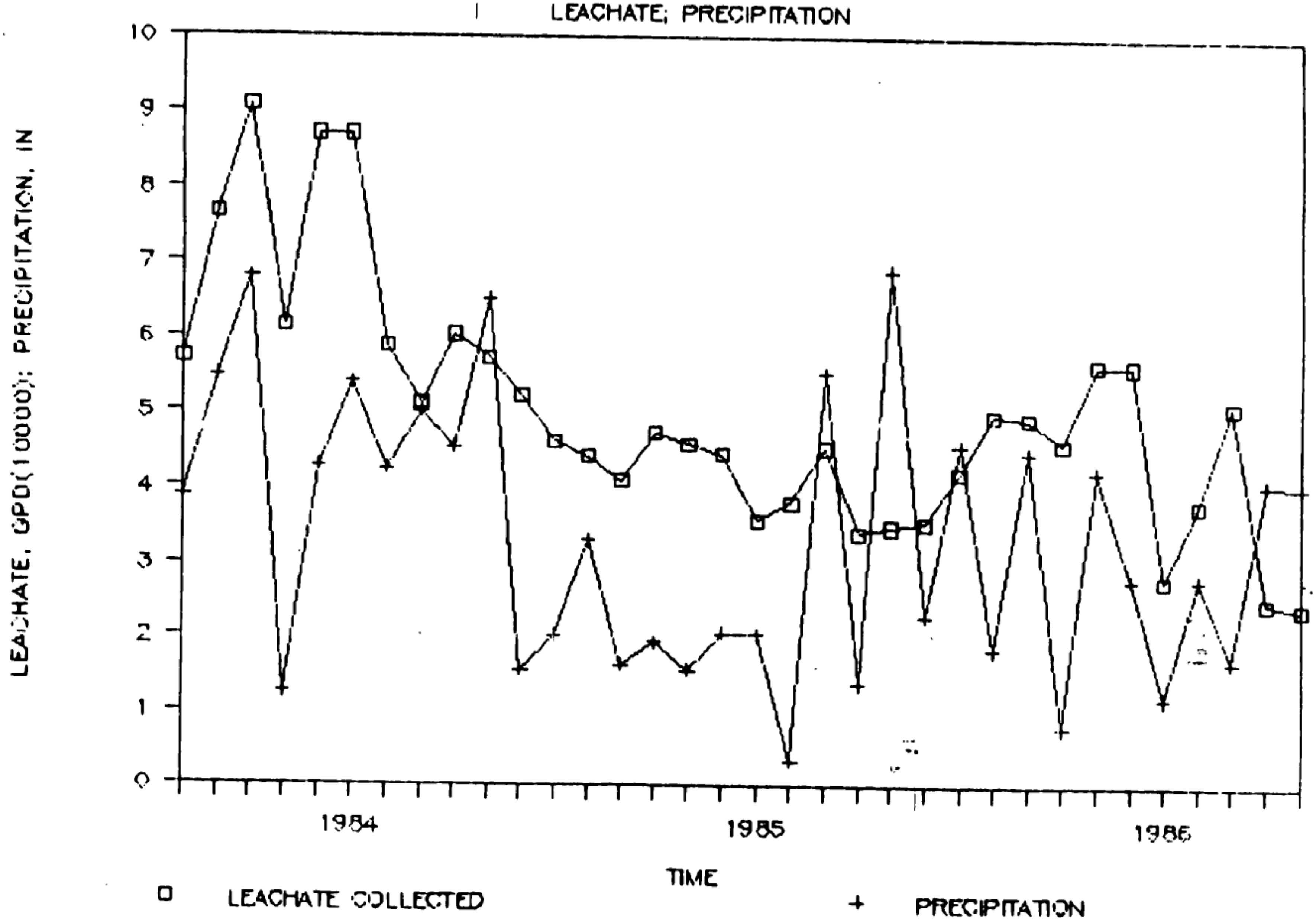


FIGURE 9:

HISTORICAL COLLECTED DATA



downward trend, with no or minimal dependence on fluctuations in precipitation.

The Analytical Data:

Data sets can be selected from the data base to evaluate the fate of any groundwater constituents within the landfill. The data base, in general, demonstrates the following attributes:

(a) There exists a correlation between the concentration of a given constituent observed in the base of the landfill and those observed in the collection manholes, lift stations and fire pond. This is expected since the base of the landfill wells represent four sampling points within a "pool", where the quality of its effluent is being monitored and recorded at five terminal points.

(b) Historically, concentration of a groundwater constituent at the east collection manhole and pump station represents the highest value among the five observation points within the leachate collection system.

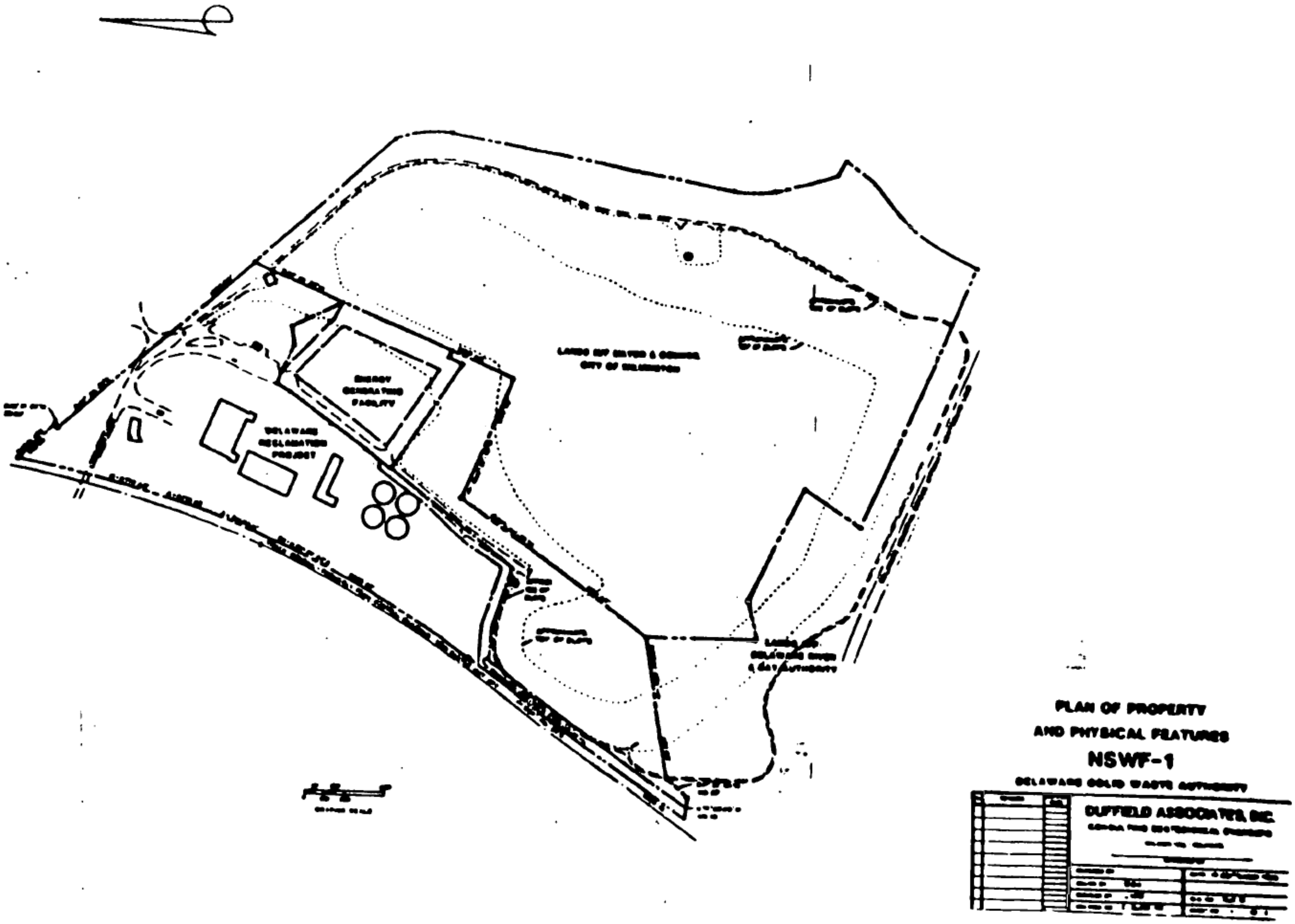
(c) Unless it is a local phenomenon, in the absence of any "in-flow" to the system (landfill), the concentration values observed in the perimeter observation wells should not exceed those observed at points in the base of the landfill or those of leachate collection.

The reported analytical data for September 1984 - March 1985 do not follow these trends. In the case of Arsenic, for example, concentrations reported in perimeter wells 28 and 29

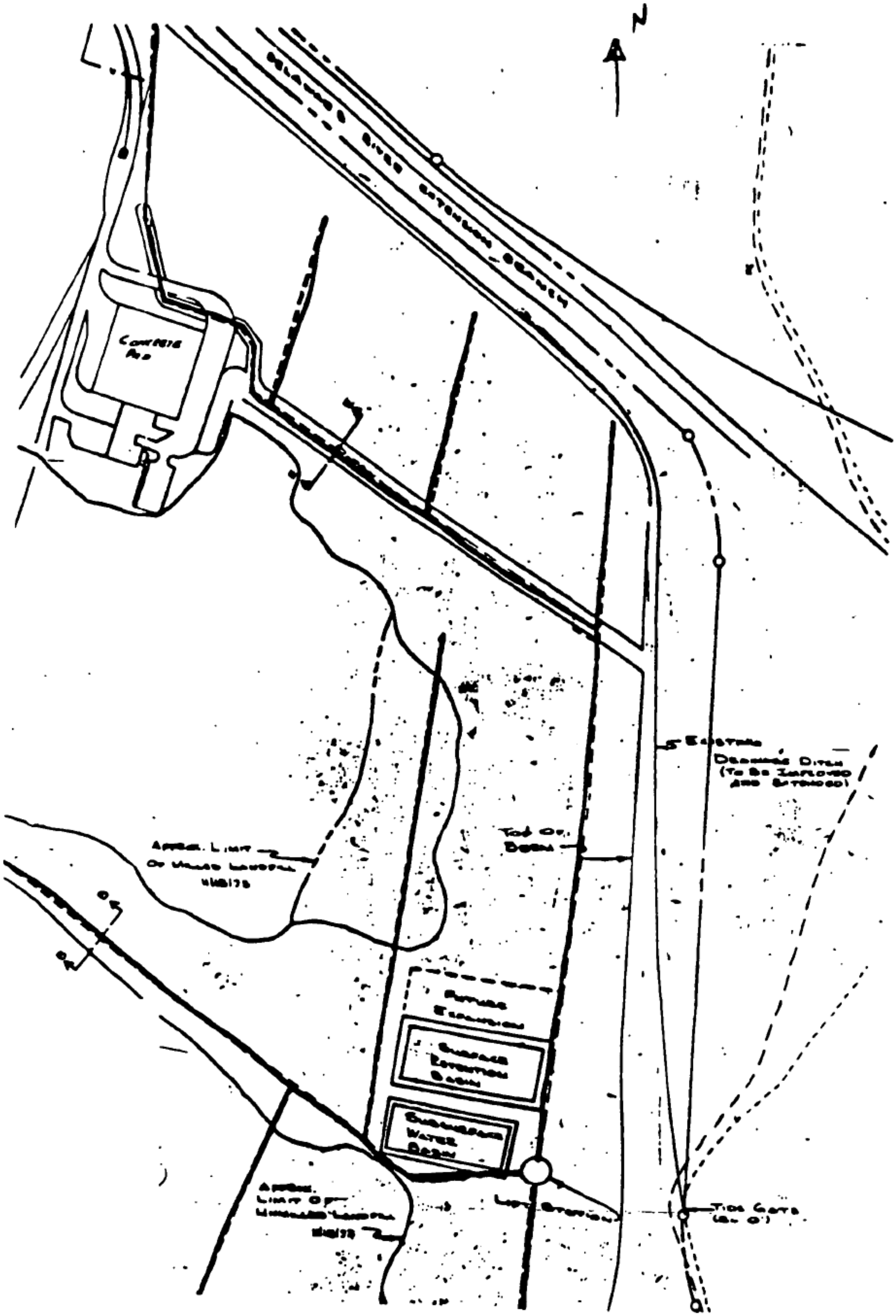
(Potomac Formation) for March 1985 by far exceed the highest concentration ever recorded, before or after March of 1985, in the base of the landfill or points of leachate collection. These values and those for the parameters analyzed and recorded for the same period of time should, therefore, be considered questionable which suggest possible error in sampling and/or laboratory analysis.

Conclusion:

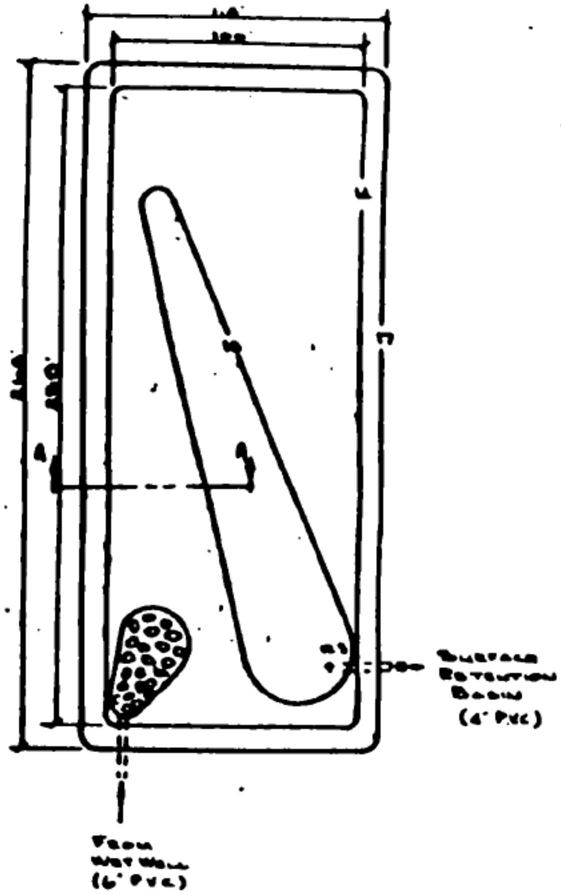
A wealth of information was collected during the operation of the Pigeon Point Landfill, essentially by the DSWA, and is being continued after its official closure. The existing data do not provide evidence of groundwater contamination at the site. The reported values for September 1984-March 1985 represent an erratic period in the data collection, with a questionable validity, as discussed earlier in this report.



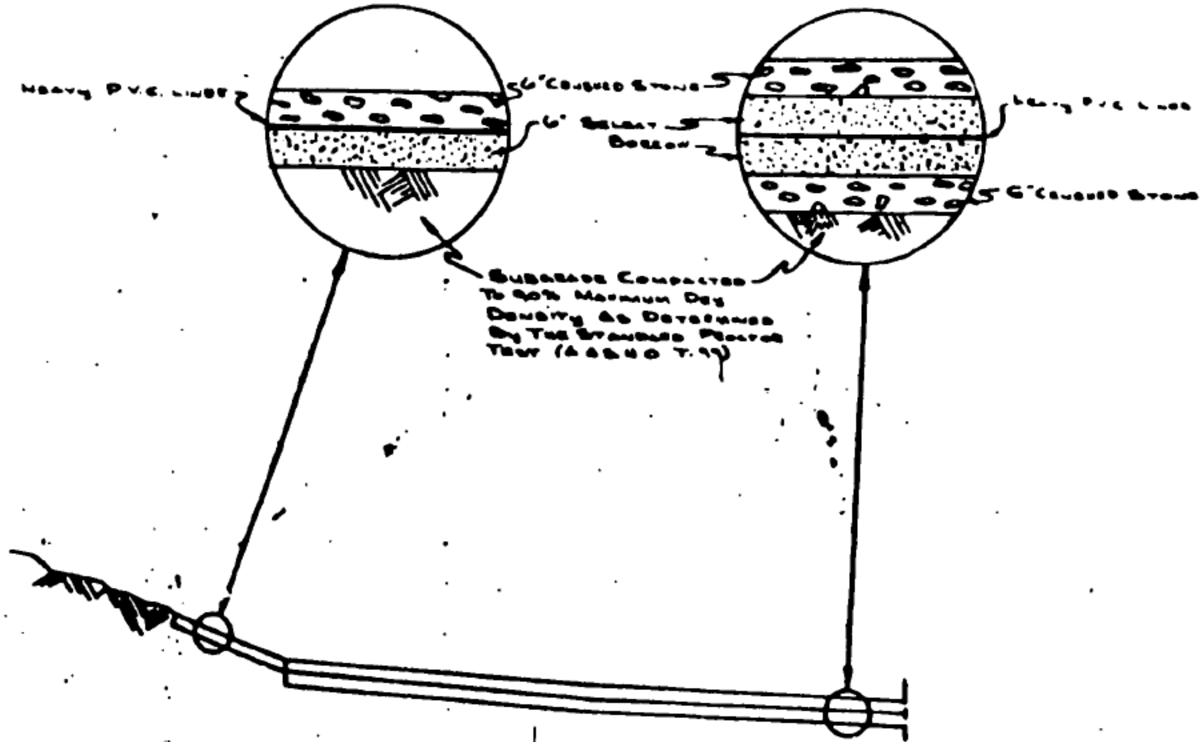
DRAWING I



DRAWING II

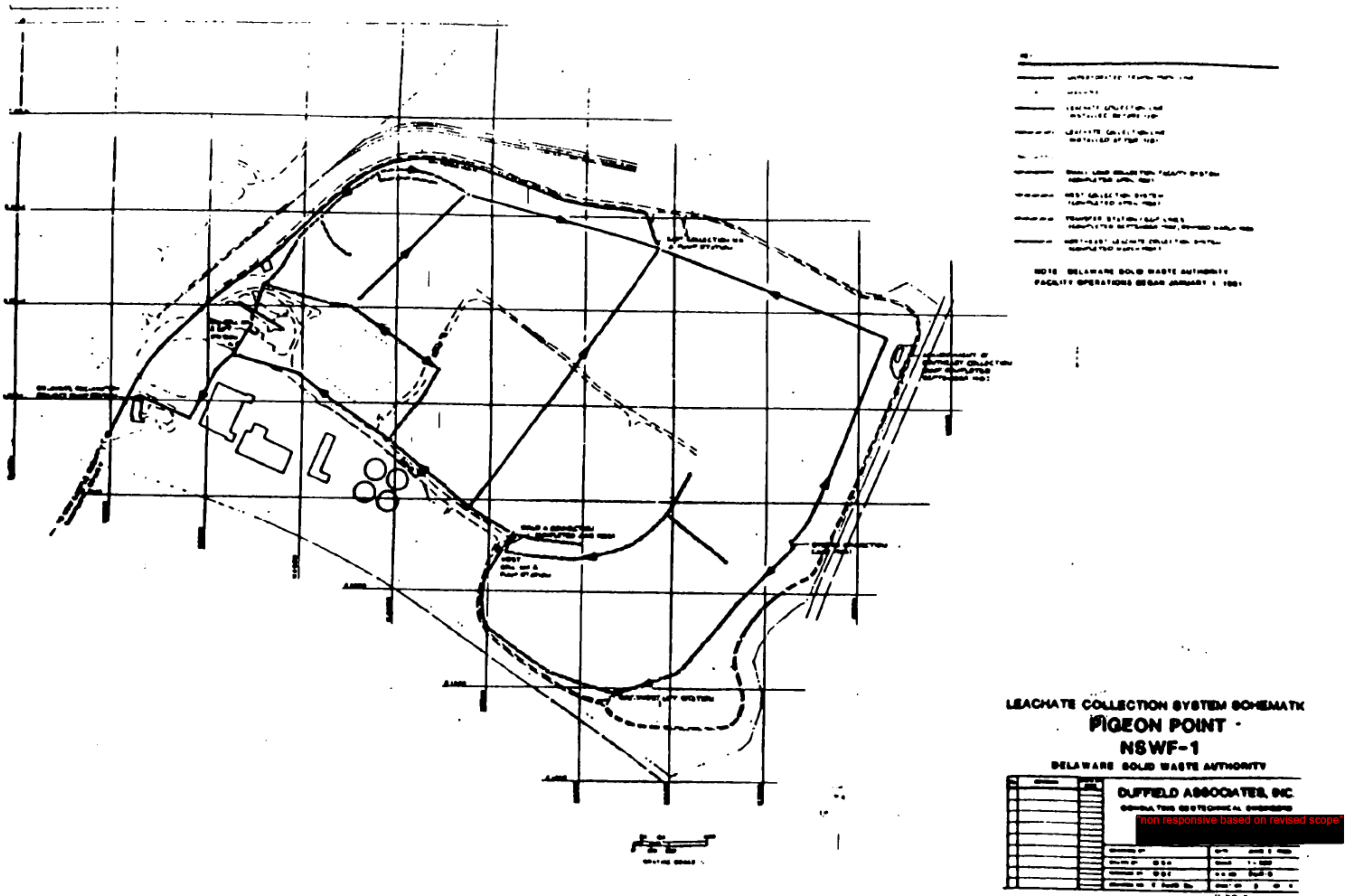


Subsurface Water Basin

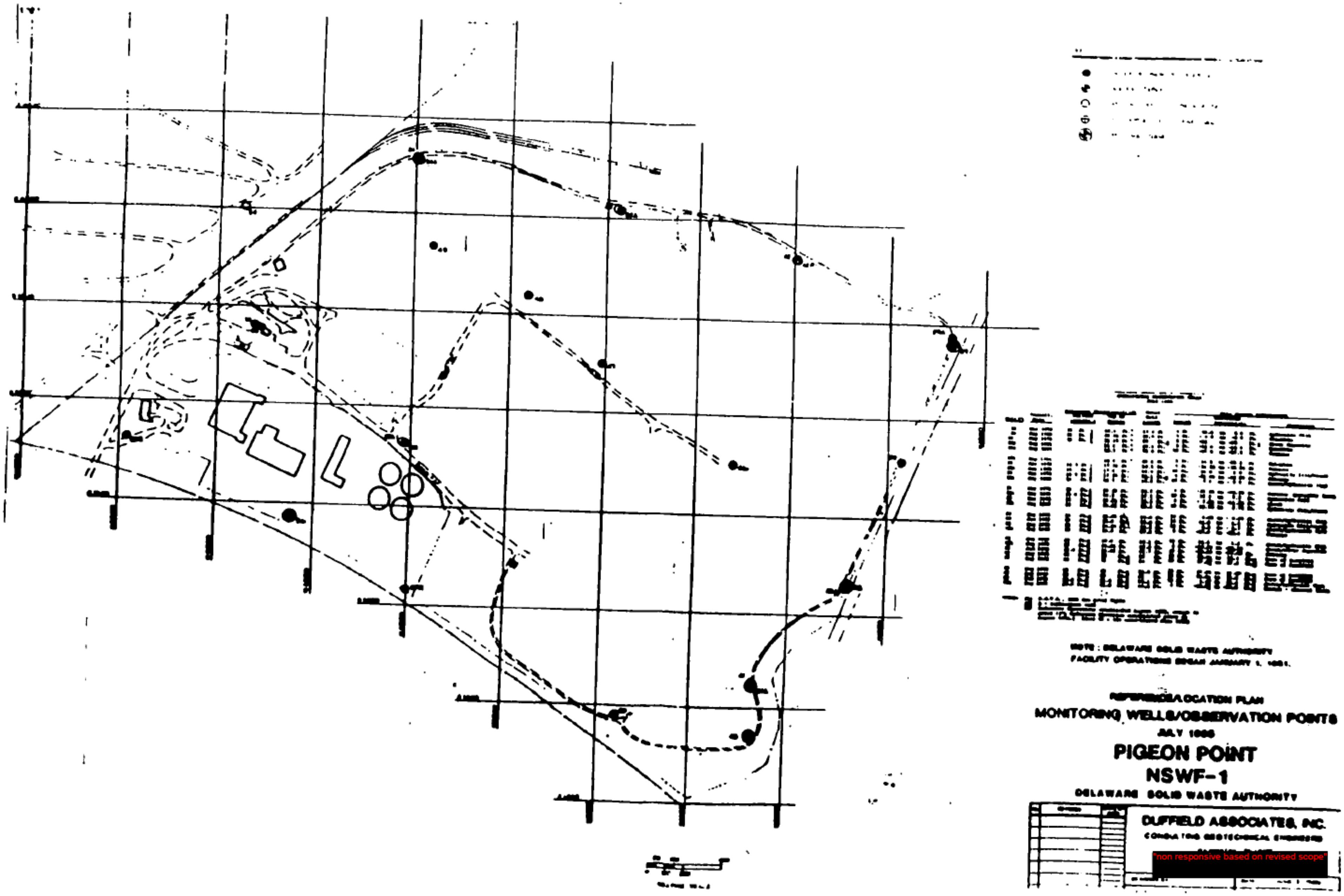


Typical Crossection
Subsurface Water Basin
Section A-A

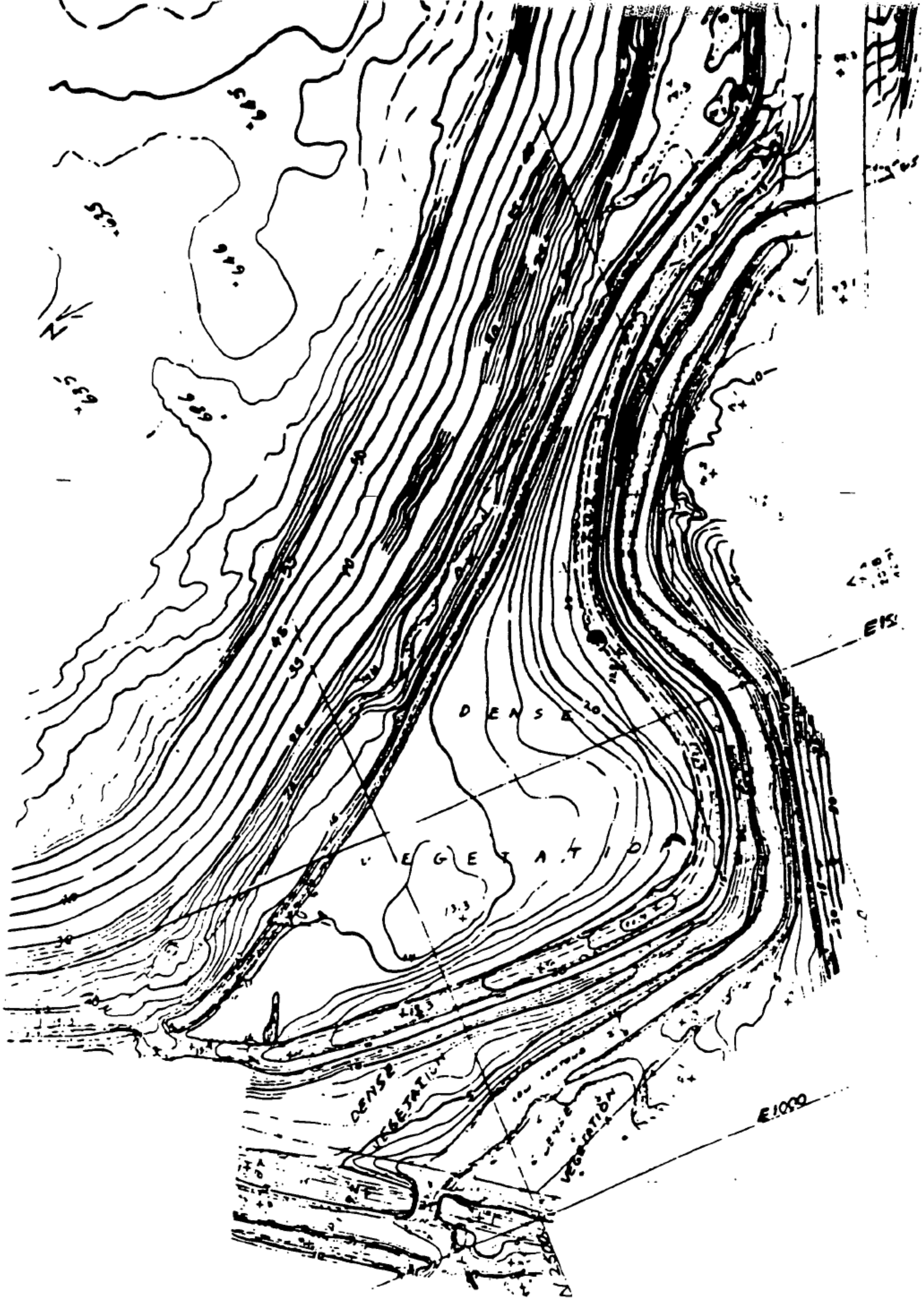
DRAWING III


LEACHATE COLLECTION SYSTEM SCHEMATIC
PIGEON POINT
NSWF-1
DELAWARE SOLID WASTE AUTHORITY
DUFFIELD ASSOCIATES, INC.
[redacted] "non responsive based on revised scope"

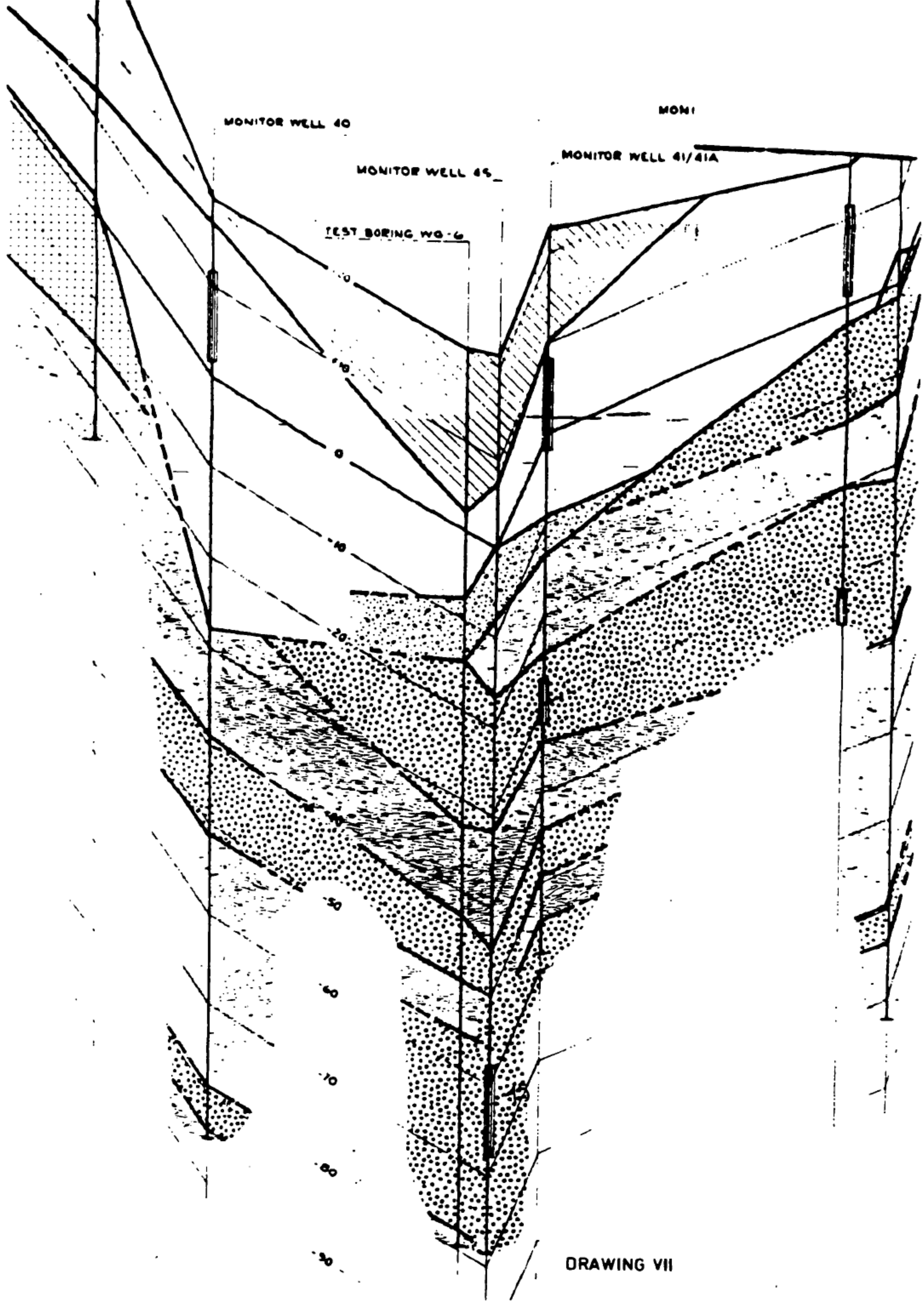
DRAWING IV


NOTE : DELAWARE SOLID WASTE AUTHORITY
FACILITY OPERATIONS BEGAN JANUARY 1, 1981.
MONITORING WELLS/OBSERVATION POINTS
PIGEON POINT
NSWF-1
DELAWARE SOLID WASTE AUTHORITY
DUFFIELD ASSOCIATES, INC.
"non responsive based on revised scope"

DRAWING V



DRAWING VI


MONITOR WELL 40
MONI
MONITOR WELL 41/41A
MONITOR WELL 45
TEST BORING WO-6
10
0
10
20
40
50
60
70
80
90

DRAWING VII

ATTACHMENT 2

JUN 25 1987

P. O. BOX 1791
Lexington, SC 29072

Delaware Solid Waste Authority
℅ Parkowski, Noble, Guerke, PA
P. O. Box 598
Dover, DE 19903

Attn: Mr. Jeramy Homer

Dear Mr. Homer:

As the founder, president and one of the principle technical people in Brandt Associates, Inc., I am writing this letter at your request to give an assessment of certain arsenic values reported to the Delaware Solid Waste Authority during the period of April-May, 1985.

The situation during the period in which the experimental testing in question was performed was such that Brandt Associates, Inc., a Delaware corporation, was under extreme economic distress. A change of management of the laboratory business was in progress. The corporation shortly thereafter ceased doing business in any function.

The technical director had resigned in January and the laboratory director was terminated in March of 1985 primarily for economic reasons. The laboratory supervision was changing dramatically during this period.

The results reported for the Arsenic determination were obviously in error caused, in all probability, by technically unsophisticated office personnel transcribing data from the attached improperly filled out data sheet which under more stable conditions would have been caught in the normal review process by technical supervision. Specific items on the report sheet are annotated on the photocopy of the original data sheet which strongly suggest, if not prove, that

a. the data on the sheet refer only to the Selenium analyses, and

b. that some of data which are on the test sheet were improperly reported as Arsenic results.

An extensive review of <u>all</u> of the existing data sheets for work done during the time period involved reveals no results or data for Arsenic tests on the test well samples reported to have high arsenic values. This strongly suggests that Arsenic was never determined for these samples. The test sheets for all of the other reported results were found.

The volume of data, the diversity of tests represented, and the overall quality of the available data sheets searched, supports the conclusion that this was an isolated incident.

It should be noted that all existing test sheets and records for this time period were collected in September 1985 and stored.

Since the Arsine generator for atomic absorption and Graphite furnace were not in operation during the March to May period, they could not have been used for an atomic absorption analysis of arsenic.

A copy of the work sheet from which the data were taken for the final report is attached. A properly filled out sheet from an earlier period is also attached.

If you have further questions, please feel free to call.

Very truly yours,

M. Karl Brandt

M. Karl Brandt

MKB/mtf

METHOD OF STANDARD ADDITIONS

DATE: 5-2-85 TECHNICIAN: DE SHEET 1 of 2

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

265

STANDARD CURVES CONCENTRATION	TEST # As RESP	CALC	% R	TEST # 270 Se RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

LOG #	DILUT.	CONC. OF STD		RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393 081 114	100.811 → 25 0.248		A B C D				7	0.008	0.002
		SLOPE							
		EXTRAPOLATION		0		.102	0		~~<0.002~~
393 081 115	101.144 → 25 0.247		A B C D				1	-0.0008	-0.0002
		SLOPE				.179			<.002
		EXTRAPOLATION		0			0		
393 081 116	104.256 → 25 0.240		A B C D				5	0.005	0.001
		SLOPE							<.002
		EXTRAPOLATION		0		.189	0		
393 081 QC 115	99.898 → 25 0.250		A B C D				4	0.004	0.001
		SLOPE							<.002
		EXTRAPOLATION		0			0		
Blank	104.508 → 25 0.239						3	0.002	0.0005

COPY

No Blank, response, or calculations. Mark 4/85

COMMENTS/NOTES:

TECH ______ SUP ______ Q.C ______ LAB DIR ______ DATA ENT ______ 5.15.85

BAI 09/27/81

METHOD OF STANDARD ADDITIONS

DATE: 5-2-85 TECHNICIAN: DE SHEET 1 OF 2

SAMPLE VOLUME: ______ STANDARD VOLUME 265 TOTAL VOLUME: _____

STANDARD CURVES CONCENTRATION	TEST # AR391JC RESP	CALC	% R	TEST # 270 Se RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

LOG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393 081 110	101.181→25 0.247	A						
		B						
		C				5	0.005	0.001
		D						
		SLOPE						<.002
		EXTRAPOLATION	0		.218	0		
393 081 111	100.24→25 0.249	A						
		B				4	0.004	0.001
		C						
		D						<.002
		SLOPE						
		EXTRAPOLATION	0		.259	0		
393 081 112	100.185→25 0.250	A						
		B						
		C				4	0.004	0.001
		D						
		SLOPE						<.002
		EXTRAPOLATION	0		.213	0		
393 081 113	101.511→25 0.246	A				2	0.0007	0.0002
		B						
		C						<.002
		D						
		SLOPE						
		EXTRAPOLATION	0		.171	0		

COMMENTS/NOTES:

393 081 112 spike 60 0.083 $\frac{0.083}{0.1} = 83\%$

Se 1ml 2.5 ppm

COPY

TECH ______ S.P. ______ Q.C. ______ LAB DIR ______ DATA ENT 5.15.8

BAI 09/27/81

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE JTH SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 RESP	CALC	% R	TEST # 270 RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

Note curves with filters

COPY

LOG #	solution initial DILUT.	final CONC. OF STD		RESP	CALC Blanks	% R RESULT	RESP	CALC	% R RESULT
* 393-079-102	100.314 D.F. = 0.249	25	A					-6.1×10^{-3}	
			B	17	0.55-0.1	<0.025	2 curve 112	-0.006	~~-0.001~~ <0.002
			C	$\frac{0.45 \times 25}{100.314} \div 0.55 = 0.020$					
			D						
			SLOPE						
			EXTRAPOLATION	0			0		
* 393-079-103	100.618 D.F. = 0.248	25	A				4 curve 112	-3.4×10^{-3}	
			B					-0.003	~~-0.0007~~ <0.002
			C	10	0.33-0.1	<0.025			
			D	$\frac{0.23 \times 2.5}{100.618} \div .55 = 0.010$					
			SLOPE						
			EXTRAPOLATION	0			0		
* 393-079-104	100.161 D.F. = 0.250	25	A				5 curve 112	-2.1×10^{-3}	
			B					-0.002	~~-0.0005~~ <0.002
			C	11	0.36-0.1	<0.025			
			D	$\frac{0.26 \times 2.5}{100.161} \div 0.55 = 0.012$					
			SLOPE						
			EXTRAPOLATION	0			0		
* 393-079-105	99.991 D.F. = 0.250	25	A	9	0.30-0.1	<0.025	3 curve 112	-4.7×10^{-3}	~~-0.001~~
			B					-0.005	<0.002
			C	$\frac{0.20 \times 2.5}{99.991} \div 0.55 = 0.009$					
			D						
			SLOPE						
			EXTRAPOLATION	0			0		

393-079-103 Spiked | 100.145 D.F. = 0.250 | 25 | 88 | 2.78 | recovery 61% | 55 | 0.065 | ~~0.0162~~

COMMENTS/NOTES:

As 1 ml of 10 ppm

Se 1 ml of 2.5 ppm

$\frac{2.68 - 0.23}{4} \times 100 = 61\%$

$\frac{.065}{0.1} = 65\%$ recovery

TECH JTH DE SUP ______ Q.C. ______ LAB DIR ______ DATA ENT ______

ENT 4/29/85 KB 4/25/85 4-25-85

* FILTER PRIOR TO ANALYSIS

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE VTS SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 RESP	CALC	% R	TEST # 270 RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

COPY

LOG #	DILUT. (Sodium actual)	CONC. OF STD (final)		RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
373-078-107	100,292	25 mL	A						
			B	15	0.49 − 0.1	<0.025	8	2.0×10^{-3}	~~0.0005~~
	D.F. = 0.249		C	$\frac{0.39\times2.5}{100,292}\div.55=0.018$			curve 112	.002	<0.002
			D						
		SLOPE							
		EXTRAPOLATION		0			0		
373-078-108			A						
	100,473	25 mL	B						
	D.F. 0.249		C	17	0.55 − 0.1	<0.025	10	4.7×10^{-3}	~~0.001~~
			D	$\frac{0.45\times2.5}{100,473}\div0.55=0.020$			curve 112	.005	<0.002
		SLOPE							
		EXTRAPOLATION		0			0		
373-078-109			A				2	-6.1×10^{-3}	
			B						~~-0.002~~
	99,331	25 mL	C	12	0.40 − 0.1		curve 112	−0.006	<0.002
	D.F. = 0.252		D			<0.025			
		SLOPE		$\frac{0.30\times2.5}{99,331}\div0.55=0.013$					
		EXTRAPOLATION					0		
373-078-110	102,348	25 mL	A				4	-3.4×10^{-3}	~~-0.0007~~
			B	19	0.62 − 0.1				
	D.F. = 0.244		C	$\frac{0.52\times2.5}{102,348}\div0.55=0.023$		0.025	curve 112	−0.003	<0.002
			D						
		SLOPE							
		EXTRAPOLATION		0			0		

COMMENTS/NOTES:

TECH VTS DE SUP ______ Q.C. ______ LAB DIR ______ DATA ENT [signature] 4-25-85

DAT 4/23/85

MB 4/25/85

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE JTIS SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 (As) RESP	CALC	% R	TEST # 270 (Se) RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

COPY

MKB 4/05/85

LOG #	DILUT. (solution instead)	CONC. OF STD (Final)	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393-080-114	100.563 25 D.F. = 0.249	A, B, C, D	19	0.62-0.1; $\frac{0.52\times2.5}{100.563}\div0.55=0.024$	0.025	10 curve 112	4.7×10^{-3}; 0.005	~~0.001~~ <0.002
		SLOPE / EXTRAPOLATION	0			0		
393-080-115	100.804 g 25 D.F. = 0.248	A, B, C, D	21	0.68-0.1; $\frac{0.58\times2.5}{100.563}\div0.55=0.026$	0.026	6 curve 112	-7.1×10^{-4}; -0.0007	~~0.0002~~ <0.002
		SLOPE / EXTRAPOLATION	0			0		
393-080-116	100.287 25 D.F. = 0.249	A, B, C, D	7	0.24-0.1; $\frac{0.14\times2.5}{100.287}\div0.55=0.006$	<0.025	10	4.7×10^{-3}; 0.005	~~0.001~~ <0.002
		SLOPE / EXTRAPOLATION	0			0		
393-080-117	100.351 25 D.F. = 0.248	A, B, C, D	6	0.21-0.1; $\frac{0.11\times2.5}{100.351}\div0.55=0.005$	<0.025	7 curve 112	6.4×10^{-4}; 0.0006	~~0.0001~~ <0.002
		SLOPE / EXTRAPOLATION	0			0		
Blank A	100.911 25 D.F. = 0.248		4	0.15		4 curve 112	-3.4×10^{-3}; -0.003	~~0.0007~~ <0.002

COMMENTS/NOTES: FILTER PRIOR TO ANALYSIS

393-080-114 QC	104.925 25 D.F. = 0.238		11	0.36-0.1; $\frac{0.26\times2.5}{104.925}\div0.55=0.011$	<0.025	10 curve 112	4.7×10^{-3}; 0.005	~~0.001~~ <0.002
393-080-117 QC	99.354 25 D.F. = 0.252		9	0.30-0.1; $\frac{0.20\times2.5}{99.354}\div0.55=0.009$	<0.025	8 curve 112	2.0×10^{-3}; 0.002	~~0.0005~~ <0.002
393-080-117 spike 1 ml 10 ppm As, 1 ml 2.5 ppm Se	99.871 25 D.F. = 0.250		70	2.22-0.1; $\frac{2.12-(0.155)}{4}\times100=49\%$		72 curve 112	0.088	88% rec

TECH JTD DE SUP ______ DIR ______ DATA ENT MKB

DAT 4/30/85

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DÉ VTB SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 (As) RESP	CALC	% R	TEST # 270 (Se) RESP	CALC	% R
				curve 113		
1) ~~BLANK~~				0.2 147	0.201	100.7
2)				0.1 72	0.098	98.1
~~3)~~				~~0.04 28~~	~~0.037~~	~~93.6~~
4)				0.02 16	0.021	104.7
5)				0.008 7	0.009	106.7
~~6)~~						
SLOPE				Blank 2	0.002	—

y int 0.8
slope 72
cor. coef 0.9

LOG #	DILUT. (amt initial)	CONC. OF STD (final)	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393-084-103		A						
		B	7	0.14-0.1	<0.025	3	3.0×10^{-3}	
	101.141	25ml C	$\frac{0.14\times2.5}{101.141}\div0.55=0.006$			curve 113	0.003	~~0.0007~~ <0.002
	D.F.= 0.247	D						
		SLOPE						
		EXTRAPOLATION	0			0		
393-084-104		A						
		B						
	101.175	25ml C	6	0.21-0.1	<0.025	3 curve 113	3.0×10^{-3} 0.003	~~0.0007~~ <0.002
	D.F.= 0.247	D	$\frac{0.11\times2.5}{101.175}\div0.55=0.004$					
		SLOPE						
		EXTRAPOLATION	0			0		
		A						
		B						
		C						
		D						
		SLOPE						
		EXTRAPOLATION	0			0		
		A						
		B						
		C						
		D						
		SLOPE						
		EXTRAPOLATION	0			0		

COMMENTS/NOTES:

TECH VTB DE SUP ______ Q.C. ______ LAB DIR ______ DATA ENT 4-25-85

BAT 4/30/81

MJB 4/25/85

COPY

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE JTB SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	Se TEST # 270 RESP	CALC	% R	As TEST # 265 RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
solution fixed diluted SLOPE						

COPY

LOG #	DILUT.	CONC. OF STD		RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393-085-105			A	5	5.8×10^{-3}		4	0.14-.1	<0.025 /
	102.656	2.5 ml	B	curve 113	0.006	~~0.001~~	$\frac{0.04 \times 2.5}{102.656}$ ÷ 0.55 = 0.002		
	D.F. = 0.243		C			<0.002			
			D						
			SLOPE						
			EXTRAPOLATION	0			0		
393-085-106	98.000	25 ml	A	6	7.2×10^{-3}				
	D.F. = 0.255		B	curve 113	0.007	0.002	18	0.58-.1	0.025 /
			C				$\frac{0.48 \times 2.5}{98.000}$ ÷ 0.55 = 0.022		
			D						
			SLOPE						
			EXTRAPOLATION	0			0		
			A						
			B						
			C						
			D						
			SLOPE						
			EXTRAPOLATION	0			0		
			A						
			B						
			C						
			D						
			SLOPE						
			EXTRAPOLATION	0			0		

COMMENTS/NOTES:

TECH JTB DESUP ______ Q.C. ______ LAB DIR ______ DATA ENT lls 4-26

BAI 4/30/81

MKB 4/24/85

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE JMS SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 (As) RESP	CALC	% R	TEST # 270 (Se) RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

solution used — for ?

LOG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393-086-110		A						
		B	7	0.024-01	<0.025	2	1.6×10^{-3}	~~0.0005~~
	98.580	25 ml C	$\frac{0.14 \times 2.5}{98.580} \div 0.55 = 0.006$			curve 113	0.002	<0.003
	D.F. = 0.0254	D						
		SLOPE						
		EXTRAPOLATION	0			0		

LOG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
		A						
		B						
		C						
		D						
		SLOPE						
		EXTRAPOLATION	0			0		

LOG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
		A						
		B						
		C						
		D						
		SLOPE						
		EXTRAPOLATION	0			0		

LOG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
		A						
		B						
		C						
		D						
		SLOPE						
		EXTRAPOLATION	0			0		

COMMENTS/NOTES:

TECH VTB DE SUP ______ Q.C. ______ LAB DIR ______ DATA ENT [illegible] 4/26/85

BAT 4/30/8?

MKB 4/24/85

COPY

ATTACHMENT 3

Lancaster Laboratories INCORPORATED

JUN 29 1987

June 26, 1987

Delaware Solid Waste Authority
c/o Parkowski, Noble, Guerke, PA
116 West Water Street
Dover, DE 19901

Attn: Mr. Jeremy Homer

Dear Mr. Homer:

I was asked to review and comment on the Duffield Associates, Inc. report entitled Background Information for Pigeon Point Landfill in reference to the arsenic results. The report clearly shows a significantly higher level of arsenic present in the 1985 groundwater samples (both upgradient and downgradient) than was present in data before or after 1985. The arsenic data previous to and including 1985 was not generated by Lancaster Laboratories, Inc. (LLI).

I have also reviewed the letter and raw data sheets from M. Karl Brandt to you concerning the arsenic data generated in 1985 by Brandt Associates. Further, as you recall, I joined you on a conference call with Mr. Brandt. We thoroughly discussed the procedures, techniques and data regarding the Brandt laboratory report.

LLI is qualified to comment on both the sampling and analysis of water samples for arsenic determinations. I have enclosed a current copy of the LLI Qualification Manual. The manual contains background information on our 200 person laboratory, an overview of our Technical Operations and Quality Assurance Programs, certifications (page VIII-1) and resumes of key personnel (Appendix II). My resume is found on page A-4. I have had over ten years of direct experience in the "bench level" determination of arsenic. Further, my Ph.D. research dealt with the determination of arsenic and other hydride forming elements in a variety of difficult sample matrices. My Ph.D. thesis was titled "Hydride Generation Inter-Element Interference Studies Utilizing Atomic Absorption and Inductively Coupled Plasma Emission Spectrometry".

Before drawing final conclusions from the aresenic data, one needs to examine the following possible causes of variability in groundwater samples:

Actual changes in environment
Sampling
Laboratory procedures and instrumentation
Calculation or transcription errors

Following our discussions with Mr. Brandt, I am absolutely convinced that the values reported for arsenic in 1985 were in error. In fact, apparently arsenic was never determined on these samples at all.

Three methods exist which would provide sufficient sensitivity for arsenic determinations in water. These include Atomic Absorption Spectrometry coupled with either a hydride generator or a furnace and a colorimetric hydride generation - arsine collection technique. Mr. Brandt states in his letter that the "arsine generator for atomic absorption and graphite furnace were not in operation during the March to May period..." Further, the data sheets show no raw data for the colorimetric method. There is no evidence whatever that arsenic was ever determined.

In summary, it seems unlikely that at one point in time (1985) arsenic should suddenly appear in upgradient and downgradient wells having never been there before or since. During my 15 years of environmental laboratory experience, I have never encountered another landfill in which a metal appeared at high levels in both upgradient and downgradient wells for one monitoring period and then promptly disappeared. I believe that the evidence clearly shows that arsenic was never determined on these 1985 samples from the wells surrounding the Pigeon Point Landfill.

Sincerely,

"non responsive based on revised scope" [redacted] Ph.D.
Director
Environmental Division

"non responsive based on revised scope" [redacted]

A T T A C H M E N T 4

WASH POST
3-2-87
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Selection for Superfund List Puts Utah Resort in Dumps

As EPA Reconsiders, Property Values Plunge

By Michael Weisskopf
Washington Post Staff Writer

PARK CITY, Utah—Ninety years ago, this town burned to the ground, only to rebuild more grandly. In the 1950s, when silver prices crashed and shut down its mines, Park City rebounded again as a world-class ski resort.

It is a plucky town. But now, Park City faces a survival test too complex for bootstrapping. It is trying to undo damage by a federal agency that, in an effort to save the town, has unwittingly crippled it.

Three years ago, the U.S. Environmental Protection Agency became concerned that mining wastes discovered beneath a residential-commercial subdivision posed a public health risk and recommended the subdivision for its Superfund cleanup program.

The publicity stirred by Superfund—the state's news media descended on Park City—sullied the pristine image of this town of 5,000 people. Soon, property values plunged. A hotel-condominium complex went bankrupt. The Federal Housing Administration stopped underwriting mortgages. Tourists called off ski trips. And a supermarket planning to locate in Park City postponed its plans.

Today, the EPA concedes that it may have made a mistake, a miscalculation. While there are tons of

See UTAH, A8, Col. 1

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PHOTOS BY NEAL PALUMBO FOR THE WASHINGTON POST

Kathleen McKenna, a condominium manager in Prospector, said the Superfund controversy has hurt tourist bookings.

Roy Tatton said state-sponsored blood tests, which showed high lead levels in his children, "have proven to be a farce."

Superfund Selection Stigmatizes Utah Town

UTAH, From A1

mining wastes here, the agency may have exaggerated the health risks in a rush to put the Park City subdivision on the Superfund list. It is taking another look.

While it does, some here worry that the damage has been done.

Summing up the shock waves in Park City, state Environmental Health Director Kenneth Alkema said, "If you get listed on Superfund, it's like having AIDS."

"What's on the line in Park City is the EPA's credibility," said Bill Geise, the region's top Superfund official. "I don't think we've met that test."

"It means no end to the holy war," said Park City Manager Arlene Loble. "It's a fishing expedition to find something is wrong because it's very hard for them to admit they made a mistake. I have little faith the search can have a productive end."

More is at stake here than the cleanup of toxic wastes. It is a battle for control of a city's destiny: residents who see no health risk versus regulators who do. A look at what happened here suggests bungling by state health officials, compounded by bungling by the EPA. And it demonstrates the destructive forces of politics, mass media and the marketplace when unleashed by a single government decision.

The town itself is not blameless: Is Park City protecting public image at the expense of public health?

Beneath the subdivision called Prospector lie an estimated 700,000 tons of mine tailings, the toxic debris of silver mining. Some of the highest concentrations of lead recorded in the United States have been found in the soil and household dust of the community, along with very high levels of arsenic and cadmium.

Initially, Park City officials were concerned. But after the EPA came to town, Park City hired a private consultant to challenge the EPA, tried to preempt Superfund by covering the tailings itself and, when all else failed, enlisted the aid of Sen. Jake Garn (R-Utah), a Park City resident, who simply had Prospector legislated off the list—the first site deleted in such a fashion.

"It became more important to the city to get this site off the list than to make sure the right things were done to protect the residents," said Hal Snyder, chief of Superfund site evaluation.

At least part of Park City's holy war is over self-determination, a right Utahans have cherished since Brigham Young and his Mormons fled the persecution of the East in the 1840s and stopped in Salt Lake City, 30 miles east of here. By the late 1860s, prospectors opened the first silver mines.

As fortunes were made, the shabby mining camp turned into a city of fine stone buildings and 7,000 residents. Neither the great fire of 1898 nor the Great Depression dimmed its lights. But the plunging price of silver in the 1950s closed the treasure house, and Park City became all but a ghost town.

a new answer: skiing. By the late 1970s, mountains once the motherlode of silver became the snowy diamond fields of sport. Main Street, where pick-and-shovel prospectors lavished their riches on gambling and women, was transformed with chic boutiques and watering holes of the jet set.

Twice fallen and twice reborn, Park City has made a virtue of self-reliance. "We never looked to federal money to bail us out," said City Councilman Tom Shellenberger, "and we sure don't now. We don't want them meddling in our affairs."

Despite its tradition of self-renewal, Park City failed to bury its poisons as securely as its past.

For decades, the mining companies high in the Wasatch extracted silver from ore, leaving a fine, sandy residue of worthless heavy metals. Those tailings were dumped down an underground chute, which emptied onto an undeveloped wasteland on the floor of the valley, flanked by a narrow stream named Silver Creek. The tailings area became known as the "sand dunes," where children raced bicycles, families had picnics and young couples met to watch the moon.

In the 1970s, the area was developed into Prospector, which has grown today into a community of pastel-colored frame houses of Victorian style, with turrets and gingerbread embroidery arrayed along wide streets named Wyatt Earp Way, Cochise Court, Butch Cassidy Circle and Annie Oakley Drive.

Another portion of Prospector contains a hotel, convention center, offices, athletic club, bars, restaurants and condominiums built by investors principally to rent to vacationers. The subdivision has a year-round population of about 750 and a housing capacity for 3,000 visitors.

Prospector's toxic past surfaced by happenstance. In 1983, city officials had the site's geology tested to see if it was stable enough for new construction. State engineers, in their report, noted in passing that the soil contained high metal levels. Officials alerted Utah's health department, which ran tests on the top two inches of soil, depths at which children play. The results showed:

- Lead as high as eight times the safety standard for children, who risk neurological damage from exposure.
- Cadmium at least 12 times higher than normal background levels, which represent the safety standard. The metal contributes to kidney diseases and is considered a probable human carcinogen.
- Arsenic four times higher than average background levels for the metal, considered a human carcinogen.

Soil samples taken at a depth of 12 inches also showed high levels of the three deadly metals, suggesting a significant threat to underground drinking water supplies.

The findings were alarming, and state Environmental Health Director Alkema's staff informed the EPA's regional office in Denver. The EPA asked the state to investigate the site for Superfund—the controver-

up toxic waste dumps around the country—using a special scoring system to determine if pollutants in the soil posed a danger to public health. The scoring system assesses risk from three potential pathways of human exposure: ground water, surface water and the air.

Samples of Silver Creek were taken in December 1983 to score the surface water route. All three metals had higher concentrations downstream of Prospector than upstream, with lead 20 times higher downstream. This aroused concern because water downstream is used for irrigation and because the creek empties into the Weber River.

Ground water testing was less scientific. Without performing a hydrologic test, Alkema's staff, on the basis of earlier studies, made the assumption that a shallow acquifer beneath Prospector was connected to the city's main source of drinking water and that "the potential exists" for drinking water contamination.

For the air route, the staff looked for heavy metals in household dust and found high levels, including lead 10 times higher than safety standards and cadmium 100 times higher. But the testing did not comply with Superfund's scoring procedures and was rejected by the EPA.

On Aug. 30, 1984, Alkema's office submitted its findings to the EPA and recommended that Prospector be considered for Superfund.

A year later, the EPA, relying on ground water and surface water scores provided by the state and supposedly confirmed by the EPA's quality assurance program, formally listed Prospector in the Federal Register as a candidate for Super-

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The gridlock was caused by what Geise, Superfund's chief for the Rocky Mountains region, now explains was a misunderstanding of "the way the game is played." Believing that new evidence could not be considered after a site is scored, he refused to consider the city's topsoil work at Prospector. To be consistent, he ruled out further EPA fact-finding. He now says he was wrong and should have taken new tests.

Into this stalemate stepped Garn, who tried to press the city's case. The senator found the EPA "totally uncooperative," he said. "They stonewalled any request from me or my staff or the city."

As a "last resort," he said, he tacked an amendment onto the Superfund reauthorization bill, then in its final hours of consideration last August, stating that the Prospector site "shall be deemed removed from the list of sites recommended for inclusion" in the program. The amendment passed easily among other "members' issues," which is political shorthand for pork barrel.

Garn's measure said that Prospector shall remain off the list unless new data is uncovered that "meets requirements" of the scoring system.

In Park City, Garn's move was cheered. "We all thought about popping champagne corks," said Terry Gomes, editor of The Park Record newspaper.

But it sparked a backlash at the EPA's headquarters. Hugh Kaufman, assistant to the director of the EPA's Hazardous Site Control division, said the amendment "threw a major monkey wrench" into the agency's listing process. Some of the findings at Prospector were alarming, he said, citing an October 1986 analysis by the Centers for Disease Control concluding that the tailings posed a "potential health threat."

Starting from scratch means another 18 months of delay while the site is reexamined, reproposed and subjected to another review period, he said.

Meanwhile, the controversy prompted soul-searching in Denver.

Geise said his office is preparing new tests "to do the kind of job we should have done in the first place. Even though EPA and the state of Utah have wronged Park City, two wrongs don't make a right, and walking away from a potential public health problem without determining whether it's real would not be showing good conscience."

Bob Ivory bought a four-bedroom house in Prospector five years ago for $165,000, borrowing $145,000. "We thought we had a deal," he recalled, because the bank appraiser's estimate was $30,000 more.

"Guess what it's worth today?" he asked. "I probably could get $110,000. If my financial conditions changed, and I had to sell, I'd be in real trouble."

One Prospector project already in trouble is the Carriage House condominiums, built in 1984 along with a hotel. In January 1985, 80,000 direct mail brochures were sent out promoting Carriage House. None of the mailings resulted in a sale, and last May, its owners filed for bankruptcy for the hotel-condo project.

Smith's Food King had been planning to open Park City's second supermarket, and city residents recommended Prospector among locations to be considered. The firm has decided to postpone plans until the town's property values stabilize.

Its economic life imperiled more by the Superfund cure than the toxic waste disease, Park City spent $1.7 million to cover the tailings at Prospector with six inches of topsoil, rallied its representatives in Congress and criticized the state for the miscalculations, undetected by the EPA, that justified the listing. "The state's role was pretty unconscionable," said City Manager Loble.

She called on Utah's governor for help. As the EPA deadline for comments neared, Alkema reversed. Fifteen months after recommending the site for Superfund, he opposed the listing. The scoring, he wrote the EPA, was based on "certain critical assumptions . . . which were not properly documented or otherwise substantiated in the record."

In an interview, Alkema said Superfund initially seemed like the only solution. But once the town took responsibility for the tailings, he said, there was no benefit to the program.

"We're as guilty as EPA," he said. "There wasn't adequate information to decide if the site should be listed."

Meanwhile in the EPA, a split was developing between the Denver and headquarters offices. Under pressure from Utah's congressional delegation, officials in Washington began pressing early last year for new tests to resolve the discrepancies and to assess whether the city's remedial actions had solved the problem.

"Basically, this site was not handled the way we handle all other sites," said Snyder, Superfund's site evaluation chief in Washington. "We think we have a responsibility to go out there and get good data. In this case, the region was reluctant to do additional sampling. It was gridlocked."

Park City had 60 days to appeal the listing, and hired a consultant engineering firm to prepare its case.

The firm concluded that the score for surface water was invalid because Silver Creek was tested when it was frozen. The samples were taken from storm runoff that had pooled on top of the creek. Because the runoff crossed the polluted soil, it would contain higher metal content than a naturally flowing creek.

On ground water, the firm challenged the premise, critical to the scoring, that the acquifer below Prospector was linked to the city's main water supply. There was no hard evidence to support the theory, it said.

When the review ended in November 1985, Park City called the technical work at Prospector "inaccurate, incomplete and sloppily done."

Prospector's fate hung on a final decision by EPA headquarters. Months slipped by with no decision. Meanwhile, the town's economy was slipping as Park City became a hot story for the local news media.

"The TV guys came right to our porch with the camera ready to go," said Kathy Tatton, recalling the news media attention given to three of her children whose blood tests showed high lead levels.

Kathy and Roy Tatton moved their family to Prospector in 1978, and consented to the first series of blood tests offered by the state in April 1984. None of their children showed abnormalities then. When the three children—ages 2, 5 and 7—were found to have elevated lead levels in October 1984, the Tattons sought a second opinion. They had new blood tests taken at a Salt Lake City Hospital a few weeks later. All three children tested normal for lead.

"The blood tests have proven to be a farce," said Roy Tatton.

No one questions that there is an economic problem, however. Three months after Prospector was named as a Superfund candidate, the FHA stopped insuring mortgages in the community, citing "reasonable cause of concern for health and safety." For a while, mortgage lenders redlined Prospector, frustrating efforts by homeowners to sell. Houses bought in the early 1980s for $150,000 to $250,000 were suddenly appraised for less than the mortgages on them. Dozens of families moved out and banks foreclosed, reselling the properties for as little as half of the original prices.

ATTACHMENT 5

NSWF-1
PIGEON POINT LANDFILL
MONITORING SUMMARY

Prepared For:

Delaware Solid Waste Authority
P. O. Box 455
Dover, Delaware 19903-0455

Prepared By:

Duffield Associates, Inc.
Consulting Geotechnical Engineers
5350 Limestone Road
Wilmington, Delaware 19808

"non responsive based on revised scope"

Date: 02 April 1987

[redacted].E.
Project Manager

W.O. 260-HU

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* * * * * *

APPENDIX

I. INTRODUCTION

In accordance with your request, Duffield Associates has summarized existing data, relating to subsurface stratigraphy and historical groundwater monitoring at the NSWF-1/Pigeon Point Landfill site. It is our understanding that the Authority requested these data as supporting documentation for a petition to EPA for deletion of the designated Pigeon Point Landfill site from the revised National Priorities List (NPL).

Duffield Associates has reviewed the EPA document, titled "A Hazard Ranking System for Pigeon Point Landfill", prepared by the NUS Corporation, dated 24 July 1986, and supporting documentation. From this, it is our understanding that the basis for the proposed placement of the site on the NPL is an "observed release" of four (4) contaminants (benzene, ethylbenzene, tetrachloroethylene and arsenic) from the site to the Columbia and Potomac aquifers. EPA references the sporadic detection of these contaminants in water samples from eight (8) on-site monitor wells (Nos. 25R, 27R, 28, 29, 46, 47, 48 and 49) over a twelve 12 month interval, between March 1984 and March 1985, as evidence of an observed release.

II. CONCLUSIONS

Based on our review of test borings performed at the site and the longer term record of water quality monitoring at the site, it is the opinion of Duffield Associates that:

- The EPA has <u>incorrectly</u> evaluated the monitoring data, and

- The data <u>do not</u> support the conclusion of an "observed release" of the contaminants from the site and the resulting HRS (Hazard Ranking System) score of 37.93.

This opinion is based on the following, which are discussed in Section IV, Evaluation of this report.

- The presence of the four (4) contaminants in the "Interior (Base of) Landfill" wells (Nos. 46, 47, 48 and 49), which are screened <u>within</u> the refuse fill, <u>above</u> the dredge spoils liner and <u>inside</u> the perimeter leachate collection system, is not evidence of an "observed release" of contaminants from the site.

- The indicated erratic pattern of change in contaminant concentration through time in the four (4) perimeter monitor wells (Nos. 25R, 27R, 28 and 29) is not necessarily indicative of an on-going release but, more likely, aberrations in the data record, reflecting the local, state-of-the-art capabilities in monitoring and laboratory analysis of trace organics at that time.

- Two (2) of the perimeter monitor wells (Nos. 25R and 28), cited by EPA as evidence of an observed release, are located on the "upgradient" perimeter of the site, suggesting that these water quality data may represent groundwater flowing onto the site. As such it is questionable that any suspected contamination at these locations can be conclusively attributed to a release from the site.

Therefore, it is our opinion that the large majority of the monitoring data indicate little basis for the EPA conclusion that "contaminants migrated through the base of the landfill and, in time, to and through the Columbia and Potomac Formations." Rather, it appears that the approximate twelve (12) foot thickness of low permeability dredge spoils, which underlies the fill, and the perimeter leachate collection system have, to date, provided an effective barrier to leachate migration from the site.

III. DATA

To support the above conclusion that the data do not support the proposed placement of the site on the National Priorities List (NPL), Duffield Associates has prepared the following, which are included in the attached Appendix:

- An update of Stratigraphic Fence Diagram for the site, incorporating test borings and monitor well drilling, performed by the Authority since assuming operations at the site (Plate I);

- A tabular Summary of Measured Piezometric Elevations, Groundwater Monitoring Wells for the interval from November 1982 through March 1987 (Table I);

- Indicated Potentiometric Surface Maps for both the Columbia Formation (Figure VI) and Upper Potomac Sand (Figure VII) for the interval from March 1984 through March 1985 (the period reviewed by EPA for the HRS); and

- Graphical Water Quality Summaries of monitoring data for the four (4) identified contaminants (benzene, ethylbenzene, tetrachloroethylene and arsenic) in the eight (8) designated monitor wells - Nos. 25R, 27R, 28, 29, 46, 47, 48 and 49 - (Figures III and IV) and the four (4) collection manholes/lift stations of the perimeter leacheate collection system (Figure V).

Also included in the Appendix are copies of the following plans and sketches, previously prepared for the Authority by Duffield Associates:

- Reference/Location Plan, Monitoring Wells/Observation Points, July 1985, Pigeon Point, NSWF-1 (dated 2 June 1985) (Figure I);
- Leachate Collection System Schematic, Pigeon Point, NSWF-1 (dated 2 June 1985) (Figure II); and
- Interpreted Water-Table And Leachate Mound Configuration, January 1983, NSWF-1 (dated 24 February 1983) (Plate II).

IV. EVALUATION

A. Monitor Well Location

As indicated by the attached Location Plan (Fig. I), four (4) of the monitor wells (Nos. 46, 47, 48 and 49), cited by EPA as evidence of an observed release, are "Interior (Base of) Landfill" wells. These monitor wells were installed <u>into</u> the refuse fill, above the low permeability dredge spoils which underly the fill, for the purpose of monitoring leachate quality and quantity <u>within</u> the landfill. As indicated by the attached graphical Water Quality Summaries (Fig. IV), monitoring data for these interior landfill wells (and for the leachate collection system (Fig. V)), do indicate that the referenced contaminants (benzene, ethylbenzene, tetrachloroethylene (PCE) and arsenic) are present in the raw, landfill leachate. However, the indicated leachate mound is located <u>above</u> the low permeability dredge spoils underlying the landfill and inside the perimeter leachate collection system, which encompasses the landfill. Therefore, it is our opinion that these data do <u>not</u> support the conclusion of a release of contaminants from the site.

The other four (4) monitor wells (Nos. 25R, 27R, 28 and 29), cited by EPA in the HRS, are located on the perimeter of the landfill, outside the perimeter leachate collection system. As indicated on the attached Location Plan (Fig.I), monitor wells 25R and MW-27R are screened in the Columbia (Pleistocene) Formation on the northwesterly perimeter of the site, and monitor wells 28 and MW-29 are screened in a sand within the upper Potomac Formation on the southerly perimeter. The relative stratigraphic position of these and other monitor wells, located on the perimeter of the landfill, are indicated on the attached Fence Diagram (Plate I).

B. Water Quality Data

Limited monitoring for heavy metals began in November 1980 and for selected volatile organics in August 1983. Water quality monitoring data for the four (4) perimeters wells (Nos. 25R, 27R, 28 and 29), cited by EPA as evidence of an observed release of contaminants from the site, are presented on the attached graphical Water Quality Summaries (Fig. III). Shown are the four (4) contaminants (benzene, ethylbenzene, tetrachloroethylene (PCE) and arsenic), referenced by EPA in the HRS. These graphical summaries indicate the following:

- The reported detection of these contaminants is sporadic and highly erratic, and

- There are no apparent consistent trends, which would indicate on-going release of leachate at these locations.

The apparent basis, cited by EPA, for their opinion of indicated groundwater contamination at these perimeter well sites is a tetrachloroethylene (PCE) concentration "peak" in September 1984 and an arsenic "peak" in March 1985. Review of the overall monitoring record as indicated by the attached graphs of contaminant concentration vs. time suggest that these peaks are apparent aberrations, during the "start-up" phase of metals/volatiles monitoring at the site. This opinion is based on a trend of general "non-detection" of these contaminants over the last 18 months, from September 1985 through March 1987. If these peaks were "real", they imply separate, discreet releases of two (2) distinct leachates, with no subsequent release. This seems unlikely, given the relative consistency in the leachate quality monitoring data (see Figs. IV and V), and the continued presence of the leachate mound within the landfill (see Plate II).

Additionally, these peaks generally appear (or increase) and disappear (or decrease) simultaneously at the twelve (12) monitoring locations, including the interior leachate wells and leachate collection system, without regard to relative well location or groundwater flow. Groundwater flow is slow, and it is unlikely that a contaminant could escape from the landfill, flow several hundred feet, appear simultaneously at essentially all monitoring locations, and then disappear without a subsequent trace. Based on this, it is our opinion that these peaks may probably represent sampling and/or laboratory concerns and must be viewed as questionable, based on the overall data record.

Based on the above, it is our opinion that the erratic trend in these monitoring data indicate that the 1984/1985 period, referenced by EPA, represents a probable aberration in the data, reflecting the local, state-of-the-art capabilities in monitoring and laboratory analysis of organics at that time. The possible validity of these data are to be questioned. In our opinion, there is <u>no conclusive basis</u> for the opinion that there has been <u>or</u> is a "release" of contaminants at the referenced perimeter monitor well locations. Rather, it appears that the approximate 12 foot thickness of low permeability (1 X 10 -2 cm/sec), high plasticity dredge spoils, overlying a variable thickness (5 to 55 feet) of high plasticity marsh/river deposits, and the perimeter leachate collection system have, to date, provided an effective barrier to leachate migration from the site.

C. <u>Geology</u>

The NSWF-1/Pigeon Point site is situated within the Atlantic Coastal Plain, approximately three (3) miles southeasterly of the Fall Line. The Fall Line represents the boundary between the Coastal Plain and the upland Piedmont, an area of exposed crystalline bedrock. The Coastal Plain is a wedge-shaped accumulation of unconsolidated sediments, deposited on a sloping shelf or basement of Piedmont-type bedrock. Based on reports published by the Delaware Geological Survey (DGS), the depth to weathered bedrock at this site is estimated to be approximately 400 feet.

Based on regional geologic mapping by the DGS, area Coastal Plain stratigraphy includes three (3) major geologic units, in ascending sequence: the Cretaceous age Potomac Formation, the Pleistocene age Columbia Formation, and Recent age marsh/river deposits. In addition, the site has been overlaid with an approximate 12 foot thick layer of high plasticity silt dredge spoils from the nearby Delaware River.

The lower-most formation, the Potomac, typically consists primarily of variegated silt and clay deposits, but does contain interbedded sand strata, some of which are important groundwater supply aquifers. Since the vertical and horizontal distribution of sand strata within the formation is highly variable, the location of these aquifers are not well defined or easily predicted. Test borings, performed at the site, indicate that the upper part of the Potomac Formation, beneath most of the site (to a depth corresponding to approximately elevation -90 feet, NGVD), consists of silt-clay. However, sand strata were encountered along the southerly and westerly perimeter of the site, as indicated on the attached Stratigraphic Fence Diagram (Plate I). The data also suggests two (2) sand zones in this area:

- An upper sand, represented by monitor wells 28, 29 and 41A; and

- A deeper sand, represented by monitor well 45.

The relative stratigraphic position of monitor well 26R is uncertain.

A sixth (6th) Potomac monitor well (No. 31) is located in the northeasterly corner of the site. However, this well, as indicated on the Stratigraphic Fence Diagram, is screened in a four (4) foot thick silty sand lens of apparent limited aerial extent, which is apparently hydrogeologically impeded with respect to the sand strata, screened by the other Potomac wells.

The overlying Columbia Formation typically consists of gravely, fine and medium sands with some interbedded silts and clays. Test borings, performed at the site, indicate Columbia Formation sands to be present beneath only the northerly portion of the landfill site, as indicated on the attached Stratigraphic Fence Diagram (Plate I).

The Recent deposits typically consist of soft, high plasticity silt and clay, marsh and river sediments, deposited in valleys eroded into the older Columbia and Potomac strata. The total relief on the erosion surface at this site appears to be approximately 60 feet, ranging from slightly above elevation 0 feet (NGVD) in the northerly portion of the site to below elevation -55 feet in the southeast corner of the site. As a result, the thickness of the Recent deposits is similarly variable, and depending on the depth of erosion, these deposits may completely or partially cut-off and isolate the older formations.

D. Hydrogeology

Texturally, the dredge spoils are similar to Recent marsh deposits, and together represent a thick (15 to 65 foot), low permeability (1 X 10 -7 cm/sec) liner beneath the landfill. While there may be a leaky hydrogeologic interconnection among the several geologic strata indicated on the attached Fence Diagram (Plate I), monitoring data for the site indicate that each unit has individual hydrogeologic characteristics.

- Leachate Mound

  The interior monitor wells indicate an elevated leachate mound with radial flow toward the perimeter leachate collection system. (The Authority installed the Northeast Leachate Collection System (see Fig. II) in 1984 to improve leachate control at the northern end of the site.

- Water-table

  Monitor wells (Nos. 1R, 29A, 31A, 32A, 39 and 42) are screened in the Dredge Spoils and upper portion of the Recent Marsh/River deposits, outside the leachate collection system. As indicated on the attached sketch of Interpreted Water-Table and Leachate Mound Configuration, January 1983 (Plate II), observed piezometric level in these wells is higher than that observed in the nearby collection system. This implies an outside water-table gradient and lateral flow back toward the leachate collection system. This indicates that the leachate collection system is apparently functioning as a hydraulic barrier to lateral migration of leachate from the mound within the landfill.

- Columbia (Pleistocene) Formation

  The attached Indicated Potentiometric Surface maps (Fig. VI) indicate a generally westerly groundwater flow potential beneath the northerly portion of the landfill site. However, the indicated flow direction has been variable over time, shifting intermittently between southwesterly (toward MW-27R) and northwesterly (toward MW-25R).

- Potomac Formation

  The attached Indicated Potentiometric Surface maps (Fig. VII) indicate an easterly groundwater flow potential within the upper Potomac sand beneath the site, toward the Delaware River.

In the HRS, EPA classifies monitor well 31 as an "upgradient" Potomac well and does not recognize any upgradient Columbia wells. In addition, EPA classifies Potomac wells 26R and 29 as "side gradient" wells. The hydrogeologic data, as indicated by Figures VI and VII, do not appear to support these interpretations.

- o Assuming a more typical westerly to southwesterly flow gradient in the Columbia Formation, monitor well 25R represent an upgradient well and, therefore, provides monitoring of "background" conditions with respect to groundwater flowing onto the landfill site.

- o As noted above, Potomac monitor well 31 is, in our opinion, screened in a localized lens, which appears to be hydrogeologically impeded with respect to the larger Potomac sand units. Therefore, it is our opinion, that this well should not be considered an upgradient well for purposes of monitoring background water quality.

- o Potomac monitor well 41A (and generally monitor wells 26R and 28) are located on the indicated upgradient perimeter of the site and, in our opinion, should be used to evaluate background quality for groundwater flowing onto the site.

- o Potomac monitor well 29 is located on the easterly or downgradient perimeter of the site.

It is our opinion that these hydrogeologic data do not support the EPA position that upgradient monitor wells 25R and 28 are evidence for "observed release" of contaminants from the site. The three (3) organic contaminants: benzene, ethylbenzene, and tetrachloroethylene, are common industrial solvents. Given the industrialized character of the Pigeon Point area, it is our opinion that, in the absence of other verifiable "background" quality data, EPA should not utilize the questionable presence of these organics in upgradient monitor wells 25R and 28 to conclusively attribute contamination in the Columbia and upper Potomac aquifers to the Pigeon Point Landfill site.

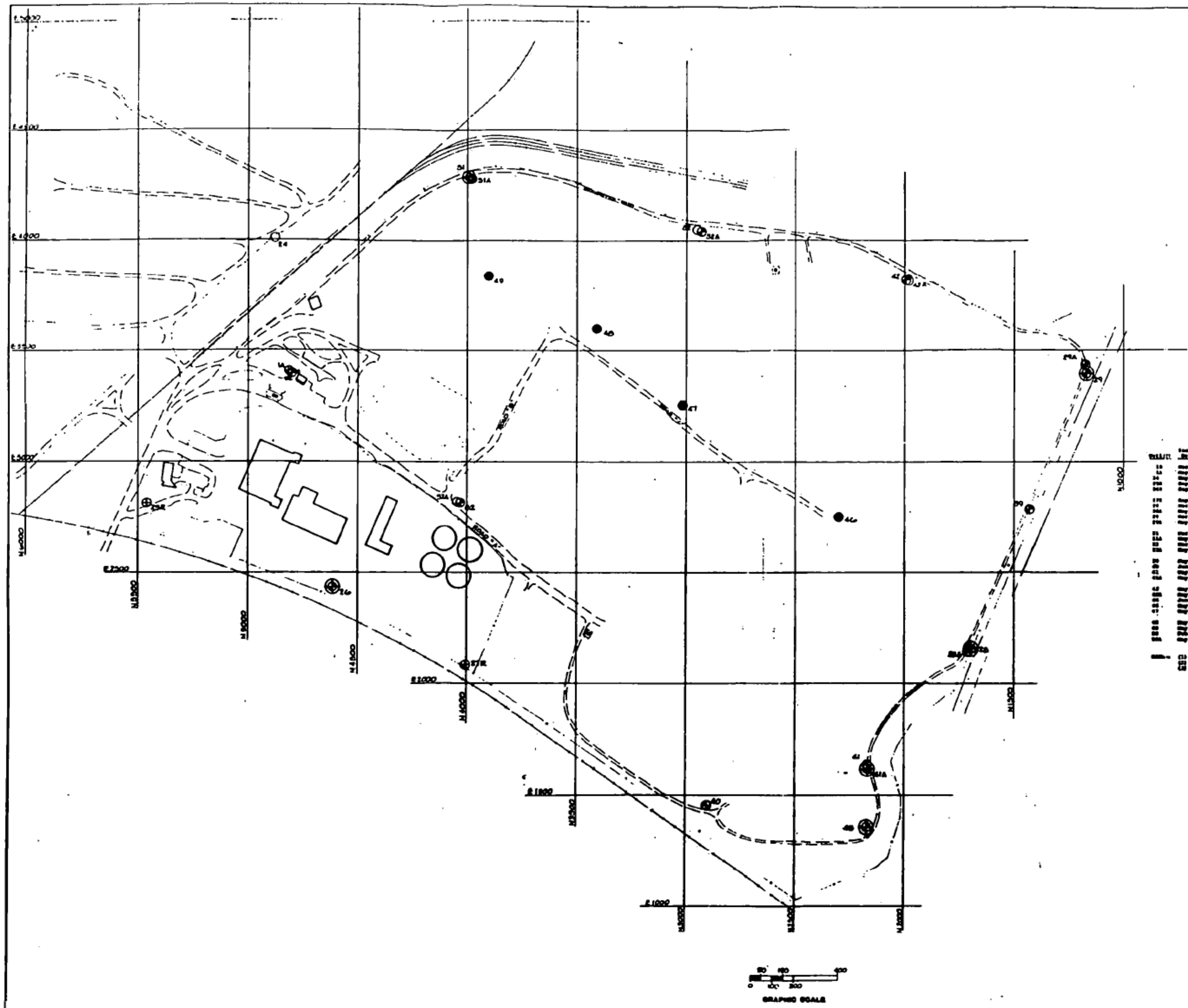
NORTHERN SOLID WASTE FACILITY-1

SUMMARY OF MEASURED PIEZOMETRIC ELEVATIONS (1) (2)
GROUNDWATER MONITOR WELLS

Monitor Well No.	Approx. Grd. Sfc. Elevation (ft.)	Measured Piezometric Elevation (ft.) 1987 March (3)	1986 Dec	1986 Sept	1986 June	1986 March	1985 Dec	1985 Sept	1985 June	1985 March (4)	1984 Dec	1984 Sept	1984 June	1984 March	1983 Dec	1983 Aug (5)	1983 May	1983 Jan
Interior (Base of) Landfill																		
47 (3)	66 ±	37±	43±	41±	41±	42±	42±	41±	41±	37±	38.5±	42±	41.5±	41.5±	43±	37±	36±	36±
48 (3)	65 ±	52±	52±	54±	53±	55±	55±	52±	52.5±	52±	53±	53.5±	N.D.	53.85±	54±	50±	49±	49±
49 (3)	65 ±	22±	24+	17+	16±	17+	17+	17±	18+	17.5+	N.D.	19.5±	19.9±	14.9±	N.D.	14+	16±	18.3±
Recent Deposits/Dredge Spoils (Water-Table)																		
1R	21	14.65	14.7	12.35	12.95	14.4	13.5	12.9	12.75	13.35	12.9	12.85	13.95	13.25	14.4	12.5	13.45	12.8
28A	16	11.75	11.8		12.15	12.4	12.05	10.9	9.15	12.5	12.1	8.9	11.9	12.45	12.25	10.4	12.35	13.15
29A	14	10.3	10.6	7.2	9.25	11.1	10.75	9.6	9.3	11.0	10.6	8.95	10.5	11.3	11.15	9.4	10.4	10.9
31A	22.5	14.15	14.25	15.4	13.15	13.55	13.2	12.6	12.8	13.0	N.D.	12.55	13.4	13.75	16.15	15.3	16.8	16.65
32A	18	13.05	13.4	10.65	11.45	14.05	13.2	12.40	11.3	12.0	12.5	11.00	12.95	14.95	14.5	11.5	13.3	13.25
39	14	11.8	10.5	9.55	10.20	11.5	10.55	10.20	11.35	11.8	10.45	10.00	10.9	11.0	11.05	10.35	11.15	11.05
40	20	14.5	15.05	13.05	13.45	14.75	14.70	14.4	13.9	13.6	13.2	13.40	14.5	14.75	15.1	14.0		
41	23	2.7	0.6	0.7	1.5	3.2	1.55	0.85	1.25	2.1	1.8	1.2	3.5	3.4	2.3	0.45	3.35	2.0
42	18	7.85	8.1	4.3	7.45	9.0	8.85	7.2	6.95	8.1	8.2	6.9	9.2	10.2	9.65	7.32	9.8	9.75
52	19	15.75	15.8	14.75	15.55	14.75	14.65	14.7	14.55	16.0	(Well installed February 1985)							
Recent Deposits - Basal Zones																		
24	30	1.2	0.95	0.15	0.65	0.95	0.95	0.25	0.4	0.4	0.65	0.6	1.5	1.45	1.45	0.9	1.9	1.4
32	18	11.3	11.25	10.9	10.9	11.6	11.5	11.1	11.2	11.9	11.8	11.65	12.05	12.3	12.35	11.95	---	12.6
42A	18	7.2	7.65	5.5	7.15	7.3	7.65	6.8	7.1	7.4	7.35	7.10	8.15	8.45	8.05	7.45	8.7	8.5
52A	19	17.75	18.25	18.65	19.40	19.45	20.50	21.25	20.2	(Well installed May 1985)								
Columbia (Pleistocene) Sands																		
1A	21	5.15	5.2	4.0	4.35	5.45	5.2	4.45	4.15	4.1	4.2	4.1	4.95	4.7	5.35	4.15	5.25	4.5
25R	9	4.5	4.45	3.1	3.5	4.10	3.45	2.6	2.75	3.25	3.6	3.95	4.45	4.3	4.5	3.9	4.45	3.8
27R	8	5.2	5.15	1.65	2.35	3.40	1.80	0.75	1.0	1.95	2.55	3.8	5.9	4.65	4.95	4.1	5.6	2.65
50	17.5	(Well abandoned February 1985)									4.15	4.2	4.95	4.75	5.05	4.2	5.3	4.6
Potomac Sands (Undifferentiated)																		
26R	10	2.15	2.75	-1.35	-1.15	-0.85	-0.7	-3.2	-2.75	-2.4	-1.95	-1.75	2.05	1.75	0.8	1.6	2.3	-0.3
28	15.5	0.8	0.1	-0.55	0.10	0.80	0.0	-0.9	-0.1	-0.4	0.20	0.45	1.85	1.1	0.5	0.35	2.05	-0.1
29	13.5	-4.3	-5.1	-5.15	-4.2	-3.35	-11.9	-5.6	-5.35	-3.35	-4.65	-5.75	-3.7	-2.05	-2.85	-4.1	-2.9	-2.1
31	23	4.2	4.05	3.6	4.15	4.7	-5.1	4.05	3.55	2.85	3.4	3.70	4.1	4.0	3.75	3.75	4.5	4.1
41A	23	1.4	2.3	0.05	0.7	1.4	-0.4	-0.35	0.4	0.25	1.05	1.10	2.45	1.6	0.9	1.1	-0.25	0.15
45	21.5	-1.2	0.6	-5.9	-6.55	-4.7	-8.15	-8.7	-7.8	-8.0	-7.44	-8.95	-0.98	-2.4	-2.9	-1.76		

NOTES:
1) Piezometric elevation determined from measured depth to groundwater, referenced to top of casing elevation.
2) All elevations based on N.G.V.D. (1929 Sea Level Datum).
3) Top of casing reference elevations for the interior (base of) landfill wells, revised February 1987.
4) Top of casing reference elevations revised January 1985.
5) Top of casing reference elevations revised August 1983.

W.O. 260-HU
Duffield Associates
2 April 1987.



Well/(?)	Install. Date	Reference Elevation(1)(3) Surface	Top of Casing	Total Well Length	Well Screen Information Length	Elevation Interval(1)	Formation
[illegible]	[illegible] 1978	[illegible]	22.4 ft.*	17.0 ft.	4 ft.	10.0 to 6.0 ft.	Hydraulic Fill
[illegible]	[illegible] 1980	[illegible]	22.05 ft.*	32.5 ft.	5 ft.	- 4.0 to -9.0 ft.	Columbia
[illegible]	[illegible] 1978	[illegible]	11.19 ft.*	99 ft.	5 ft.	-83 to -88 ft.	River deposits
[illegible]	[illegible] 1981		11.0 ft.*	30.5 ft.	5 ft.	-13.0 to -18.0 ft.	Columbia
[illegible]	[illegible] 1981		10.5 ft.*	70.0 ft.	10 ft.	-47.5 to -57.5 ft.	Potomac
[illegible]	[illegible] 1981		10.0 ft.*	30.0 ft.	5 ft.	-14.5 to -19.5 ft.	Columbia
[illegible]	[illegible] 1978	[illegible]	17.05 ft.	[illegible]	4 ft.	[illegible]	Potomac
[illegible]	[illegible] 1980	[illegible]	19.4 ft.	16.0 ft.	10 ft.	11.0 to 1.0 ft.	Hydraulic fill/marsh
[illegible]	[illegible] 1978	[illegible]	19.75 ft.	[illegible]	4 ft.	[illegible]	Potomac
[illegible]	[illegible] 1980	[illegible]	18.7 ft.	16.0 ft.	10 ft.	[illegible]	Marsh/Hydraulic fill
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

NOTES: (1) N.G.V.D., 1929 [illegible]
(2) [illegible]
(3) [illegible]

NOTE : DELAWARE SOLID WASTE AUTHORITY
FACILITY OPERATIONS BEGAN JANUARY 1, 1981.

FIGURE I
REFERENCE/LOCATION PLAN
MONITORING WELLS/OBSERVATION POINTS
JULY 1985

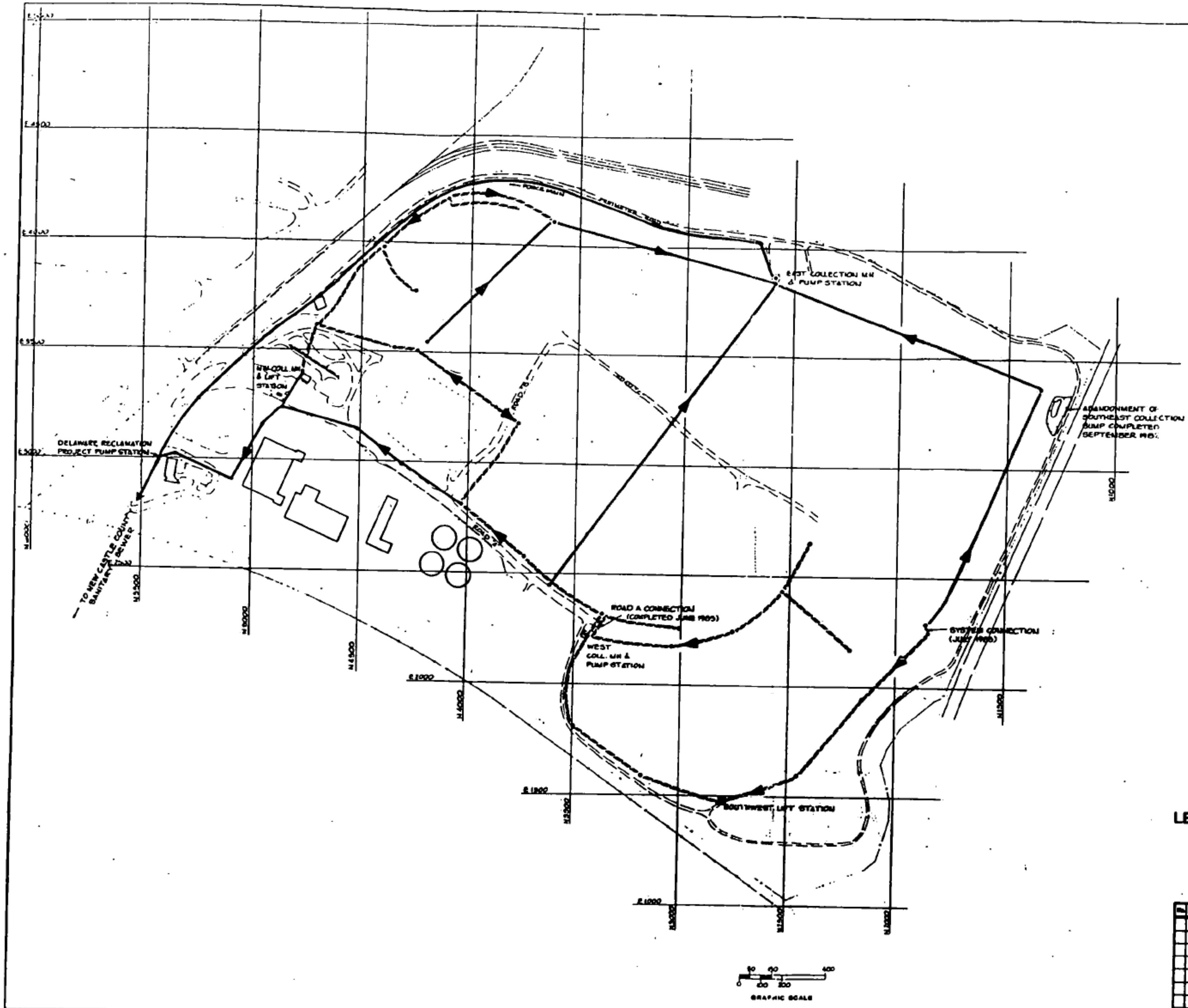
PIGEON POINT
NSWF-1

DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
"non responsive based on revised scope" [redacted]

NO.	REVISION	APPR. BY

DESIGNED BY		DATE	JUNE 7, 1985
DRAWN BY	DSH	SCALE	1" = 100
CHECKED BY	DBC	W.O. NO.	160-B
DRAWING NO.	C-1600-35	SHEET NO.	2 of 9



KEY

- UNPERFORATED TRANSMISSION LINE
- MANHOLE
- LEACHATE COLLECTION LINE INSTALLED BEFORE 1/81
- LEACHATE COLLECTION LINE INSTALLED AFTER 1/81

INCLUDING :

- SMALL LOAD COLLECTION FACILITY SYSTEM (COMPLETED APRIL 1982)
- WEST COLLECTION SYSTEM (COMPLETED APRIL 1982)
- TRANSFER STATION / EGF LINES (COMPLETED SEPTEMBER 1982, REVISED MARCH 1985)
- NORTHEAST LEACHATE COLLECTION SYSTEM (COMPLETED MARCH 1984)

NOTE : DELAWARE SOLID WASTE AUTHORITY FACILITY OPERATIONS BEGAN JANUARY 1, 1981.

FIGURE II

LEACHATE COLLECTION SYSTEM SCHEMATIC

PIGEON POINT NSWF-1

DELAWARE SOLID WASTE AUTHORITY

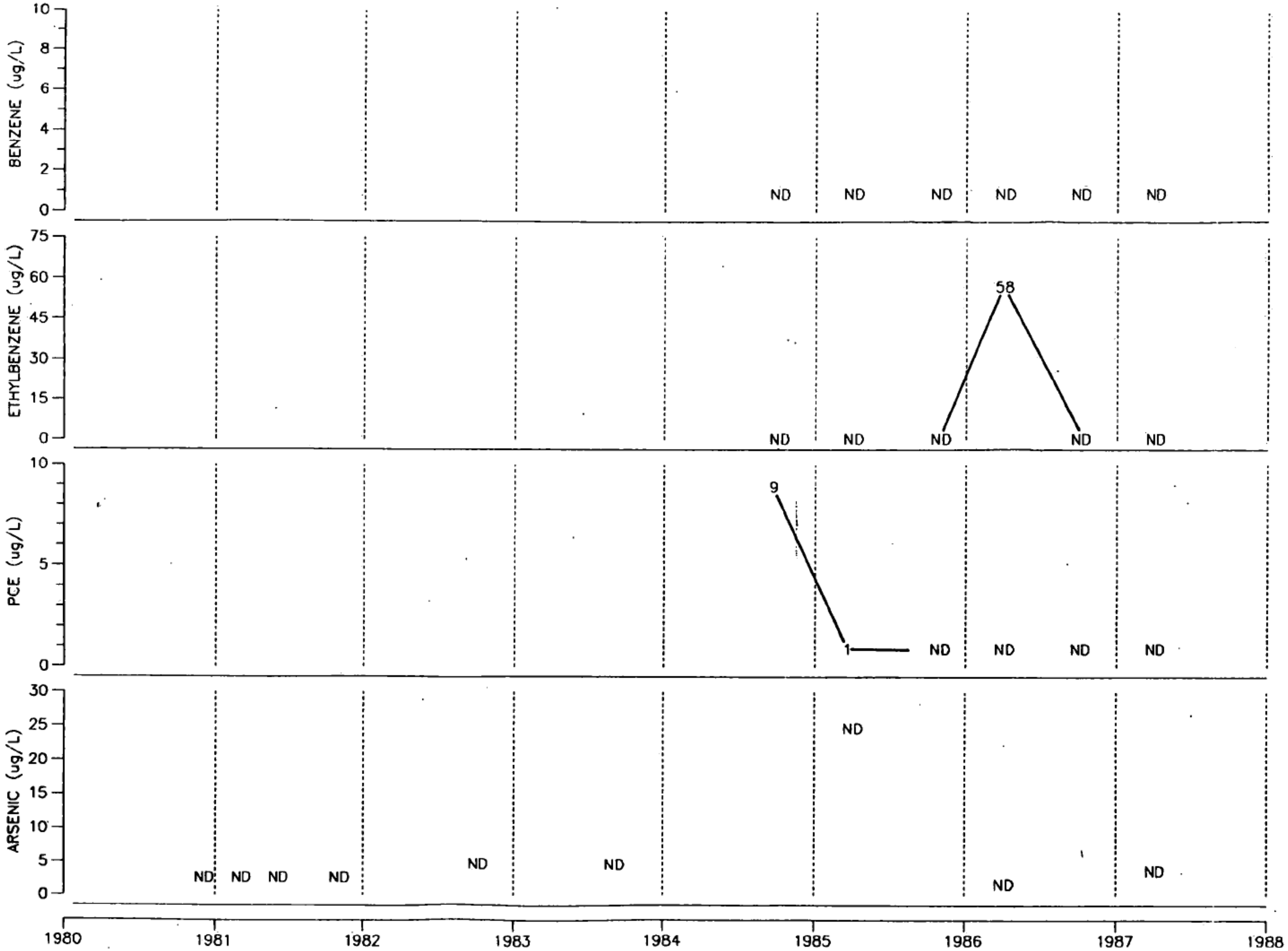
DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS

"non responsive based on revised scope"
[redacted]

DESIGNED BY		DATE	JUNE 1, 1985
DRAWN BY	DSH	SCALE	1" = 200'
CHECKED BY	DBC	W.O. NO.	260-6

Figure III. Water Quality Summaries - Perimeter Monitor Wells

- A. Monitor Well 25R
- B. Monitor Well 27R
- C. Monitor Well 28
- D. Monitor Well 29



NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE III - A

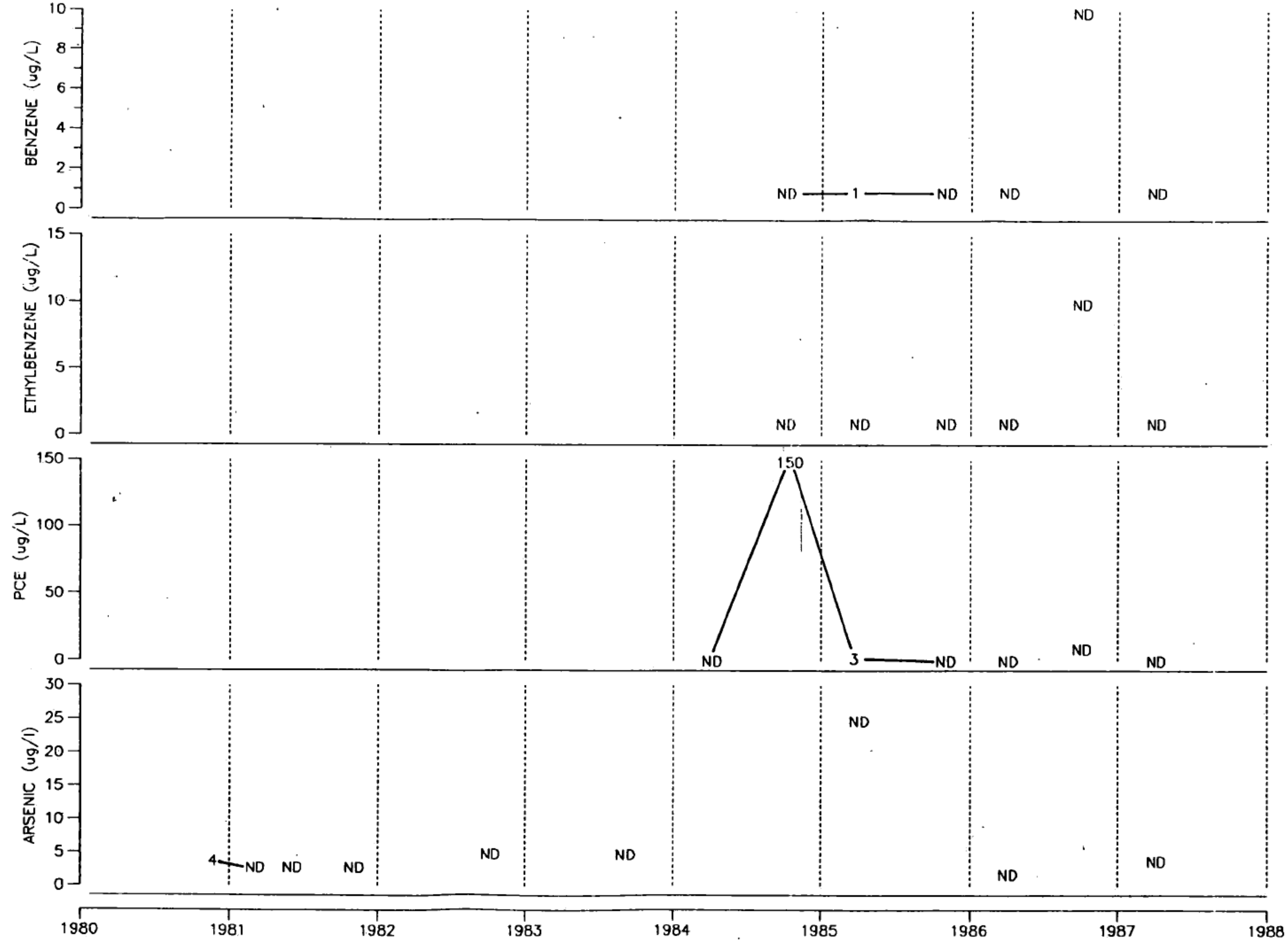
WATER QUALITY ANALYSIS

MONITOR WELL 25/25R

PIGEON POINT SITE

NSWF-1

DELAWARE SOLID WASTE AUTHORITY

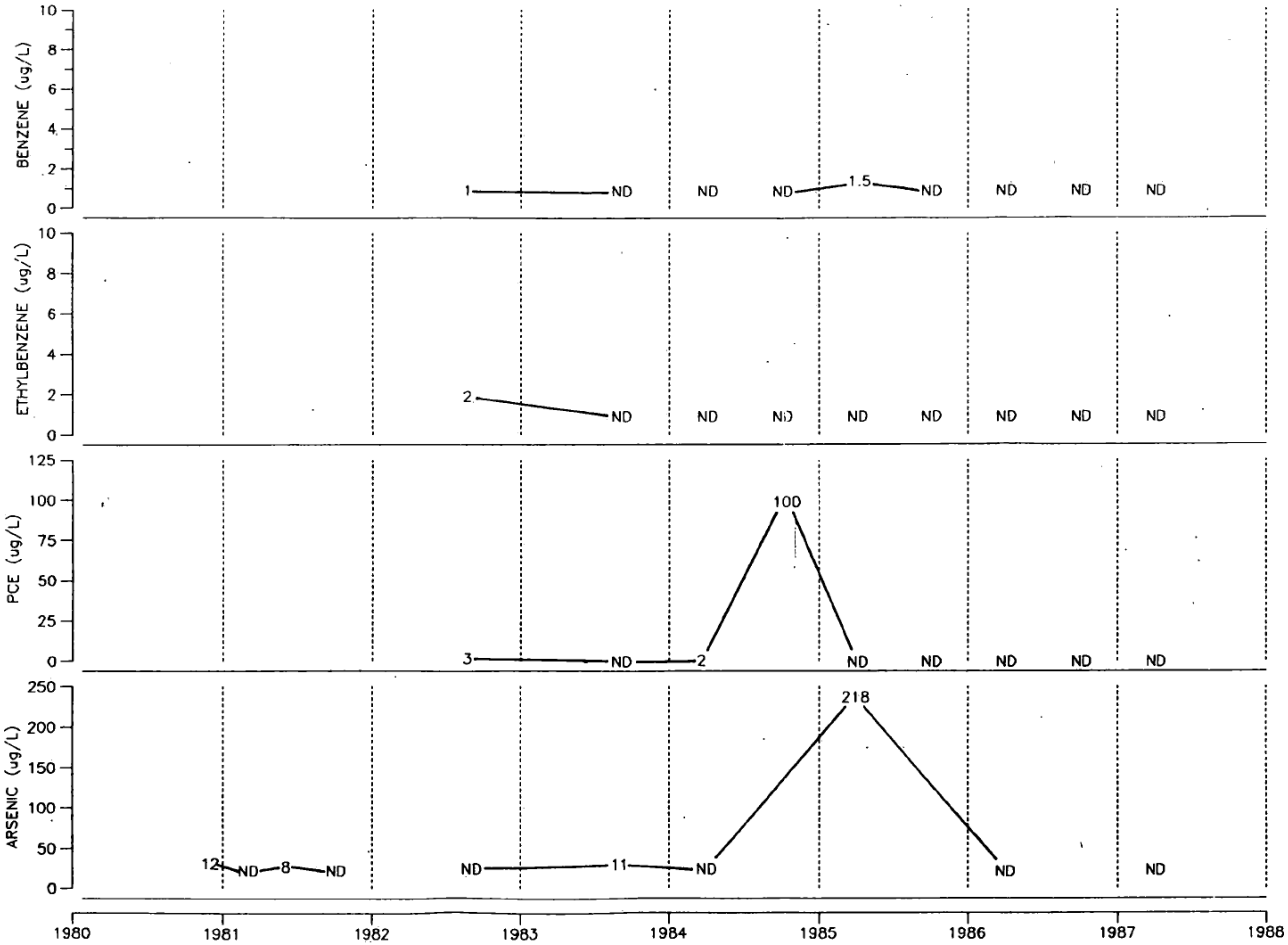


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE III - B
WATER QUALITY ANALYSIS
MONITOR WELL 27/27R
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

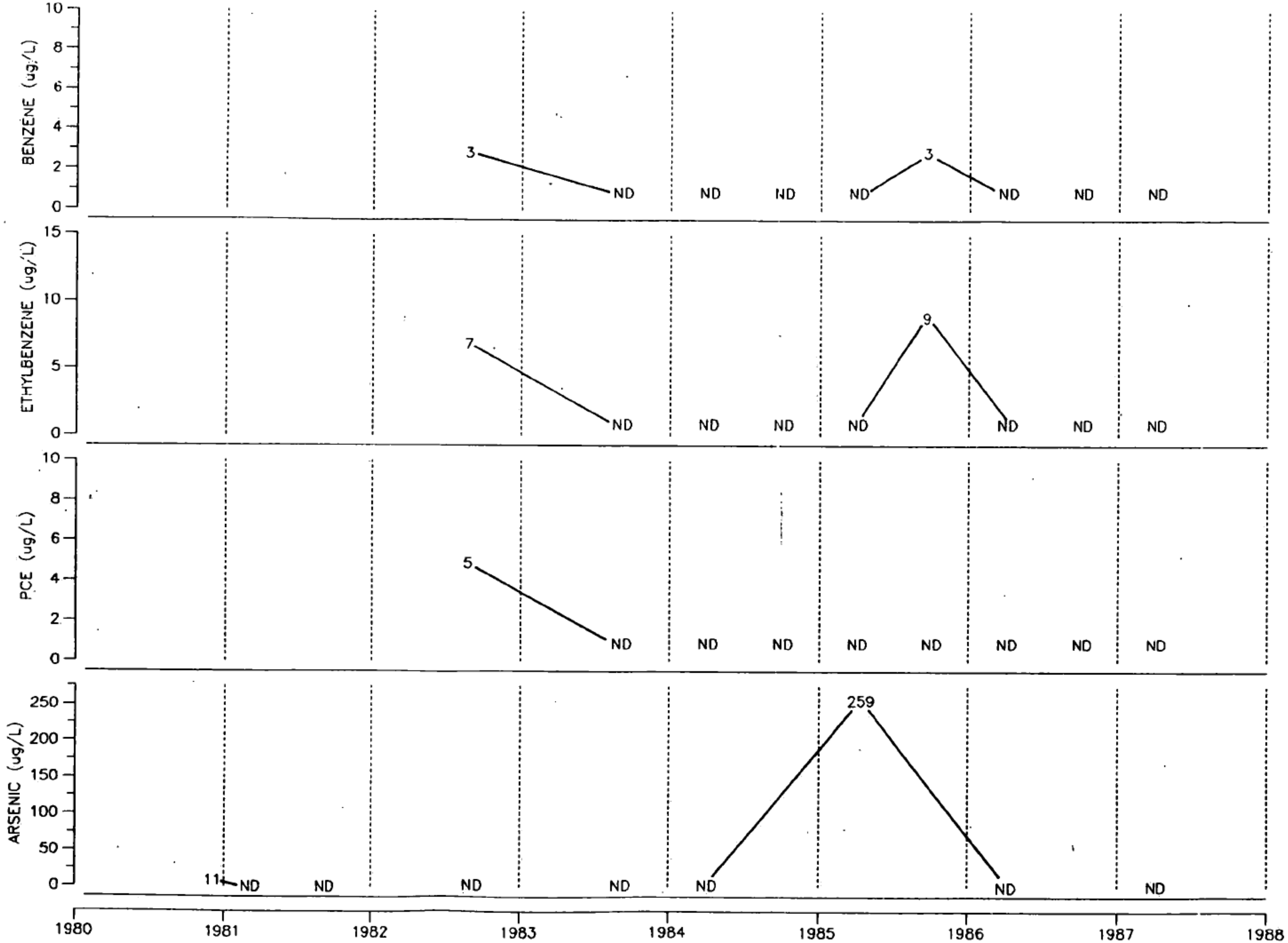


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE III - C
WATER QUALITY ANALYSIS
MONITOR WELL 28
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORIT



NOTES:

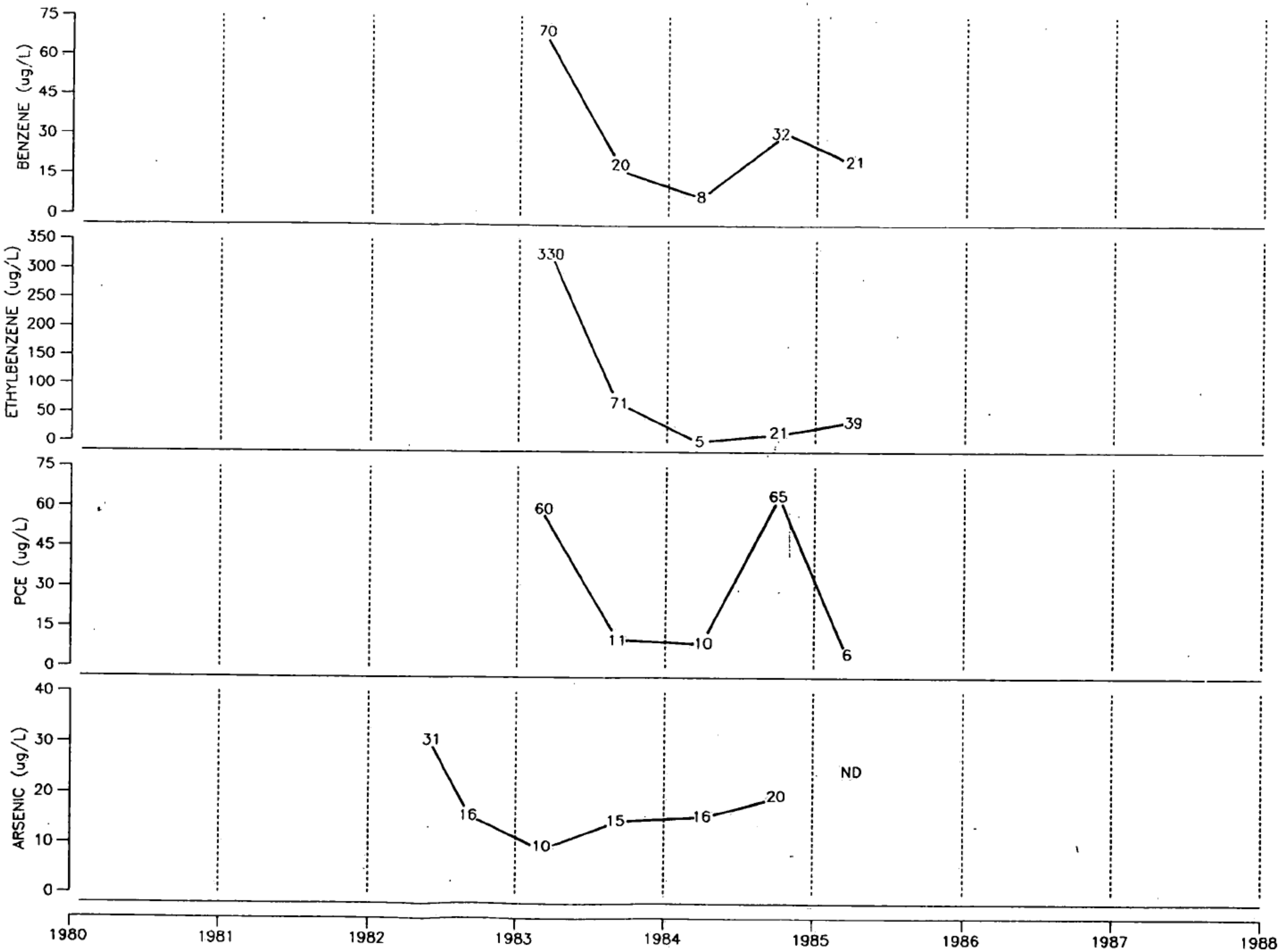
1) LABORATORY ANALYSES WERE PERFORMED PRIOR JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 19[illegible]

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE III - D
WATER QUALITY ANALYSIS
MONITOR WELL 29
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORI[illegible]

Figure IV. Water Quality Summaries - Interior Monitor Wells

- A. Monitor Well 46
- B. Monitor Well 47
- C. Monitor Well 48
- D. Monitor Well 49

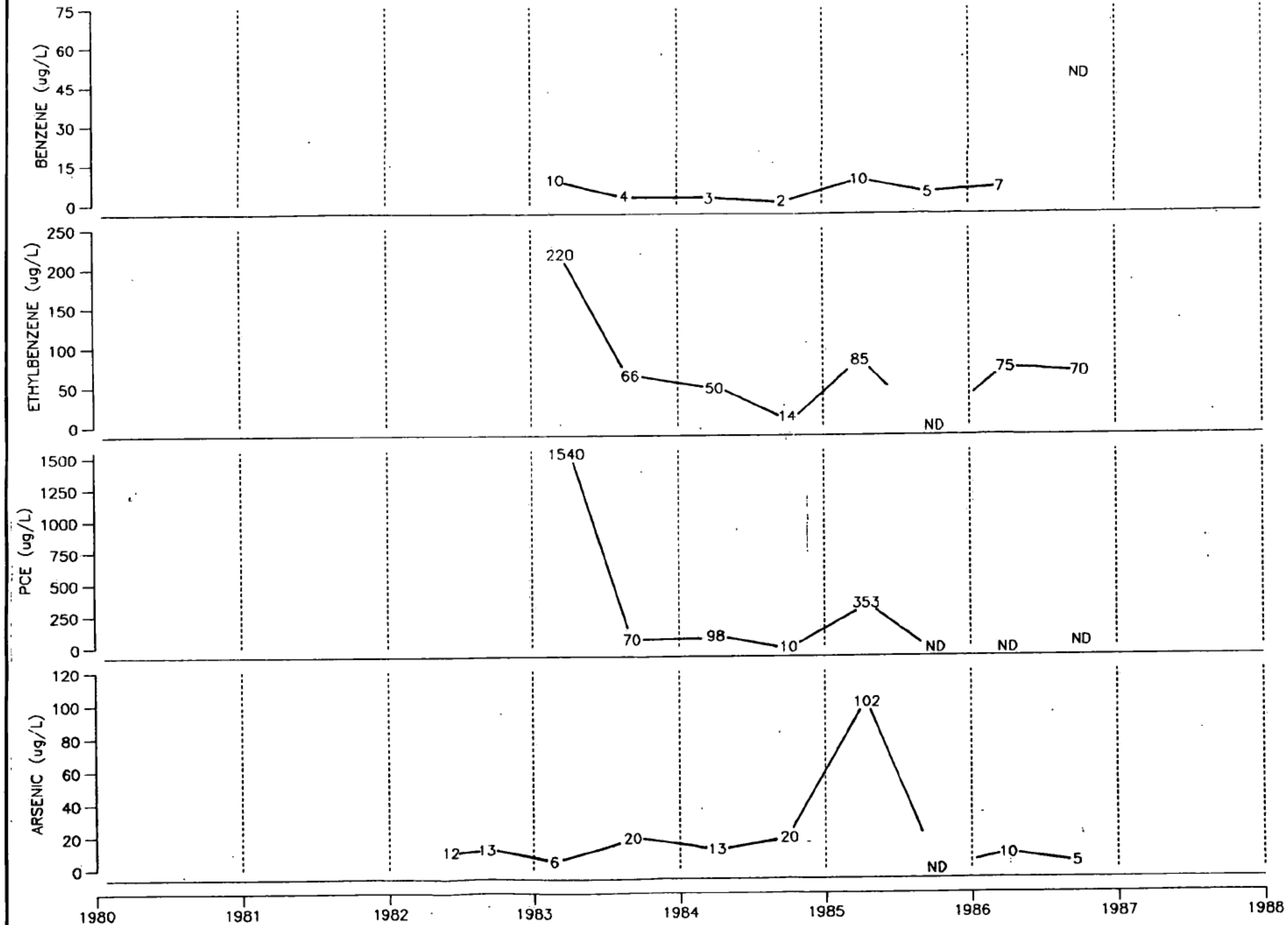


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR T JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 198

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE IV - A
WATER QUALITY ANALYSIS
MONITOR WELL 46
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORIT

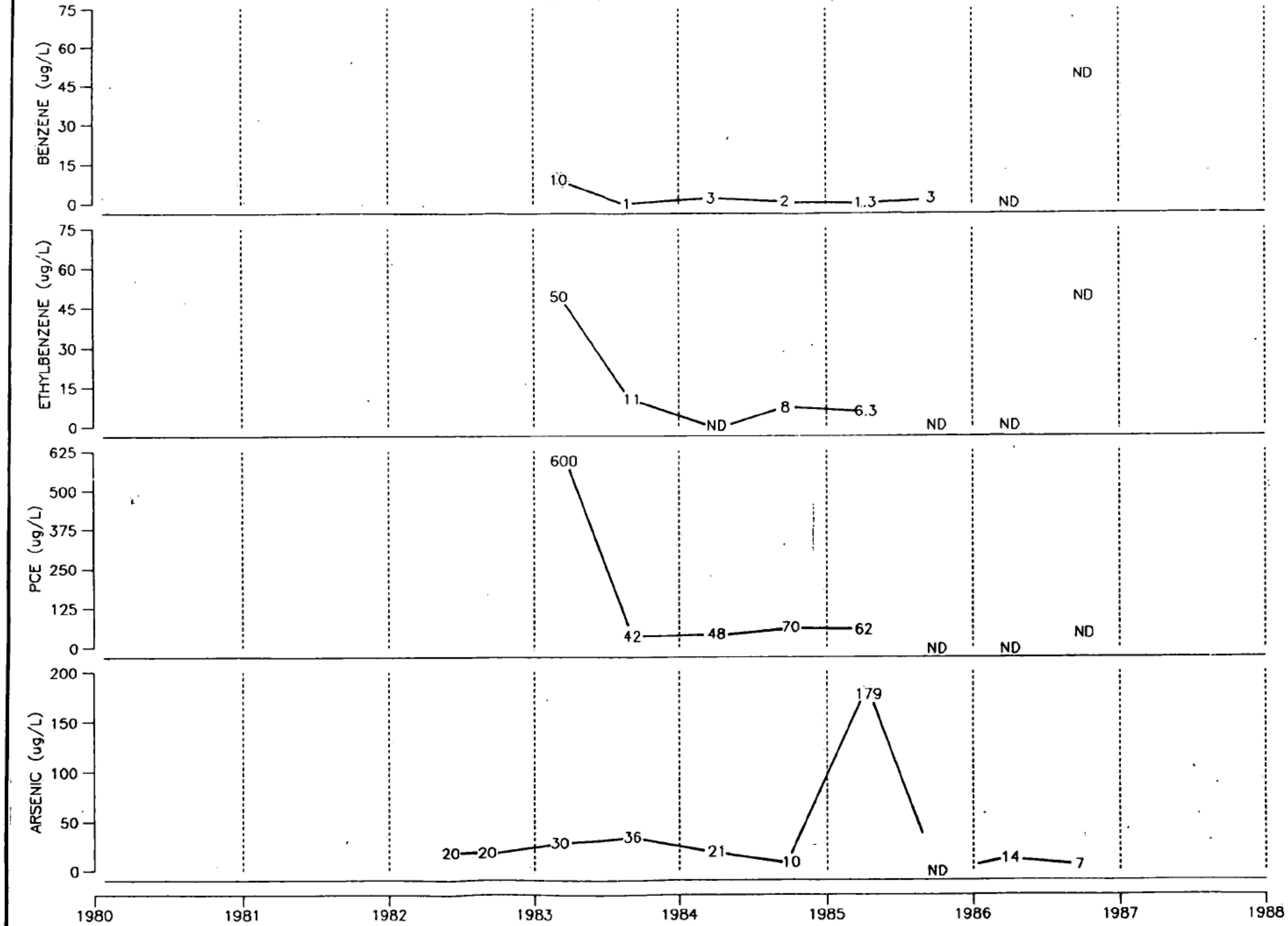


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986.

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE IV - B
WATER QUALITY ANALYSIS
MONITOR WELL 47
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

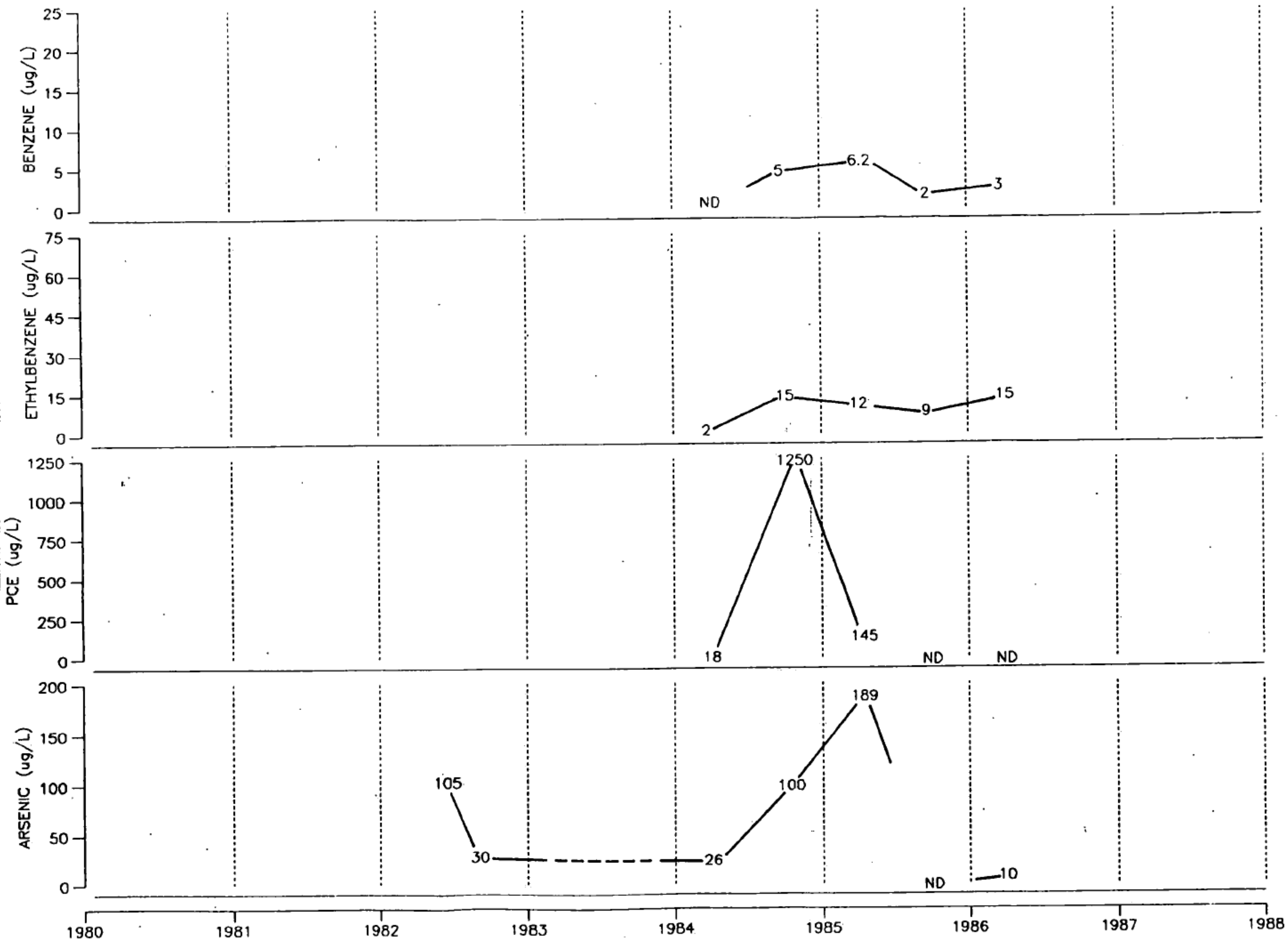


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986.

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE IV - C
WATER QUALITY ANALYSIS
MONITOR WELL 48
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY



NOTES:

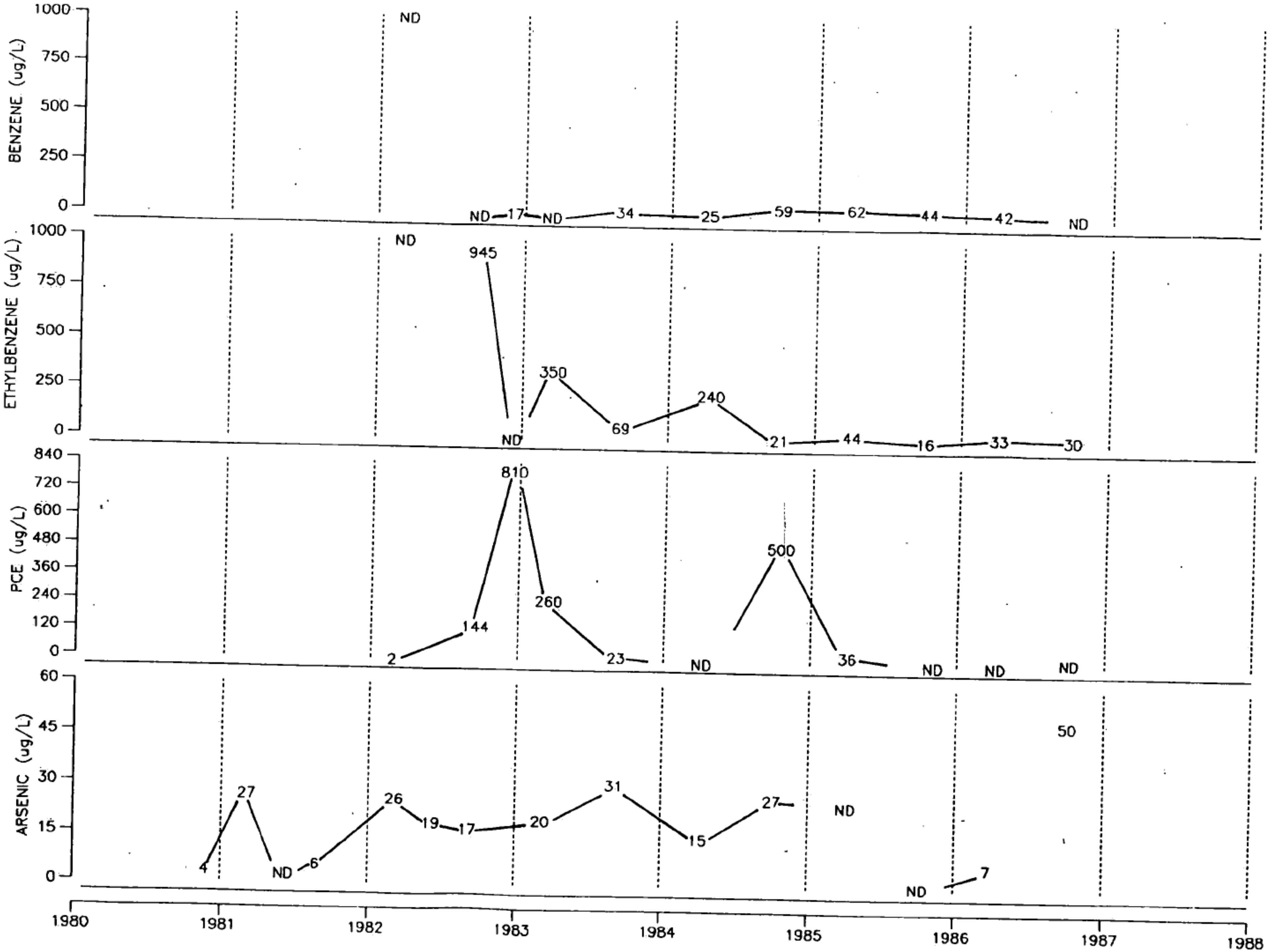
1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986.

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE IV - D
WATER QUALITY ANALYSIS
MONITOR WELL 49
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

Figure V. Water Quality Summaries - Leachate Collection System

- A. East Collection Manhole
- B. West Collection Manhole
- C. Southwest Lift Station
- D. Northwest Lift Station

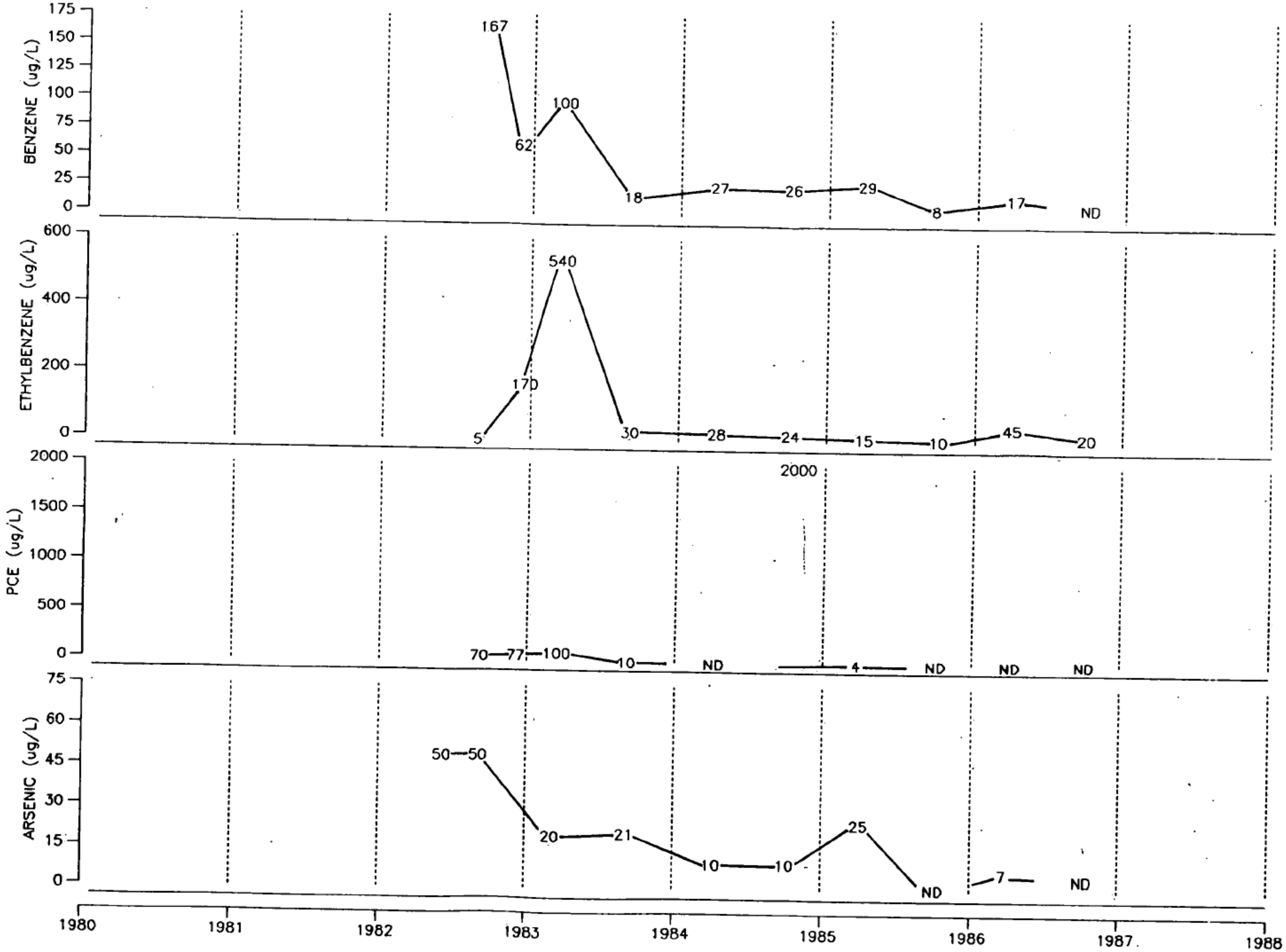


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE V - A
WATER QUALITY ANALYSIS
EAST COLLECTION MANHOLE
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

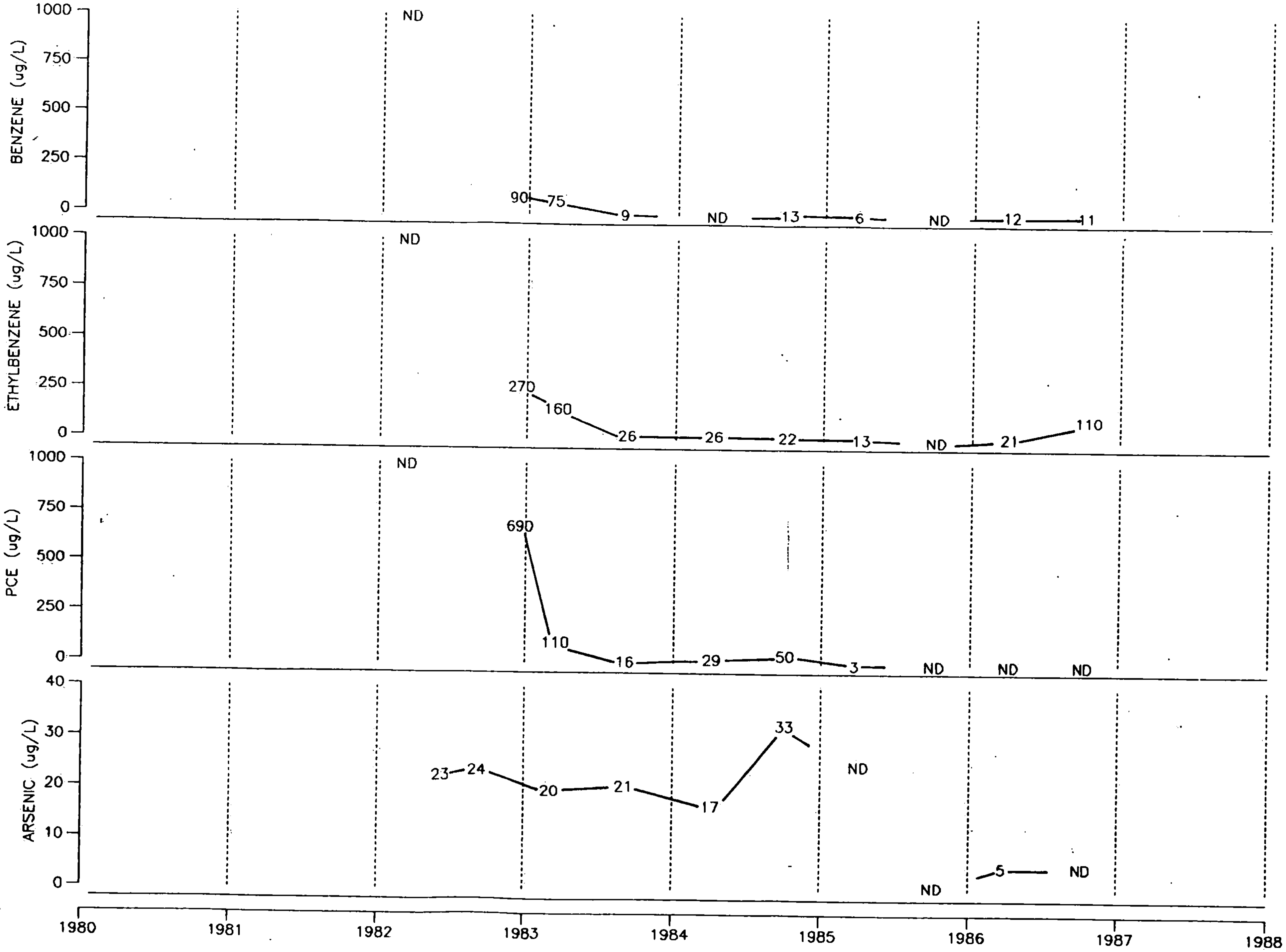


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986.

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE V - B
WATER QUALITY ANALYSIS
WEST COLLECTION MANHOLE
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

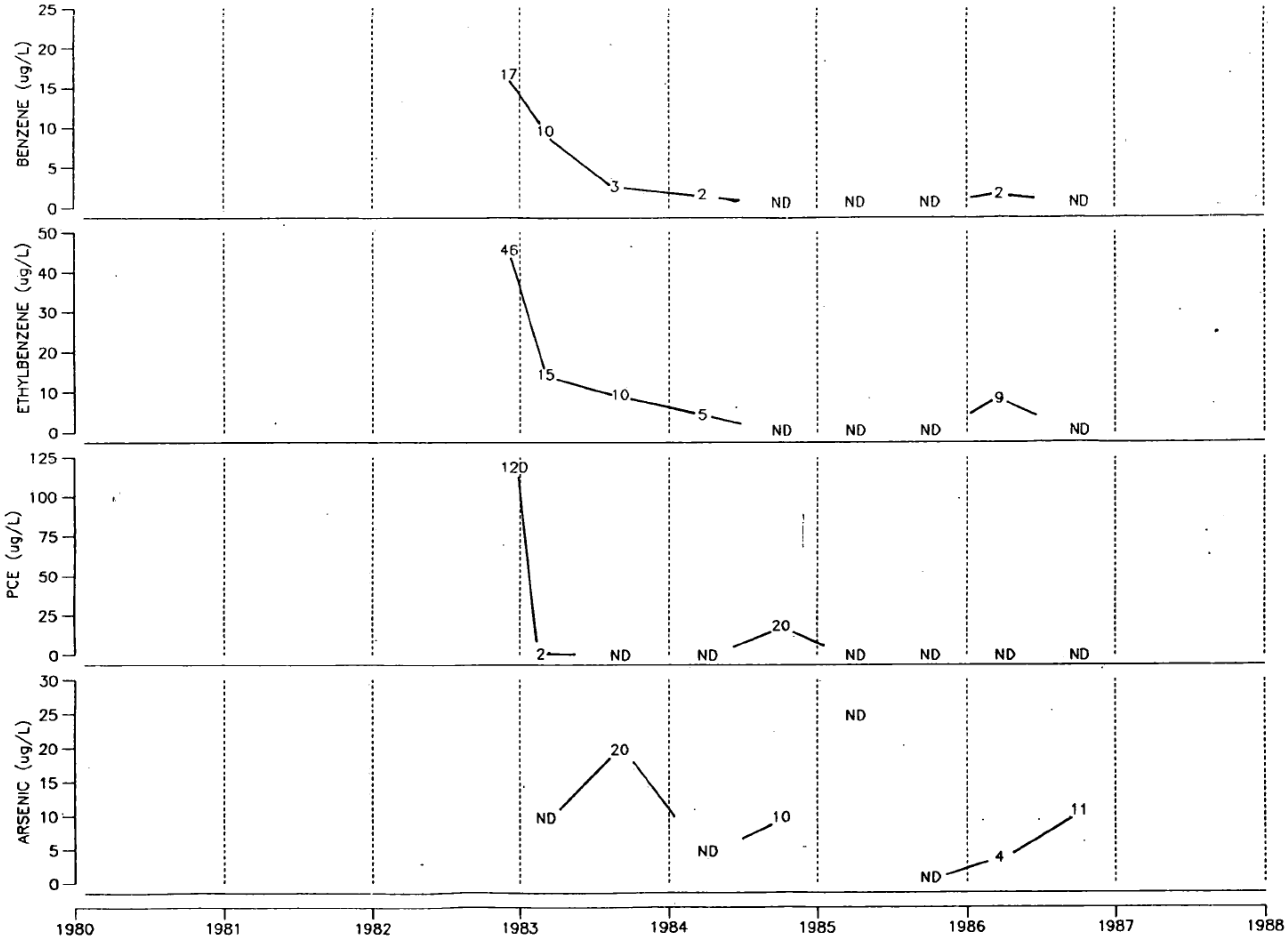


NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR T(JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE V - C
WATER QUALITY ANALYSIS
SOUTHWEST LIFT STATION
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORIT'



NOTES:

1) LABORATORY ANALYSES WERE PERFORMED PRIOR TO JUNE 1985 BY BRANDT ASSOC., INC., FROM JUNE 1985 TO JUNE 1986 BY COOPERATIVE VENTURES, INC., AND AFTER JUNE 1986.

2) ND - NOT DETECTED (PLOTTED AT REPORTED LABORATORY LOWER DETECTION LIMIT).

FIGURE V - D
WATER QUALITY ANALYSIS
NORTHWEST LIFT STATION
PIGEON POINT SITE
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

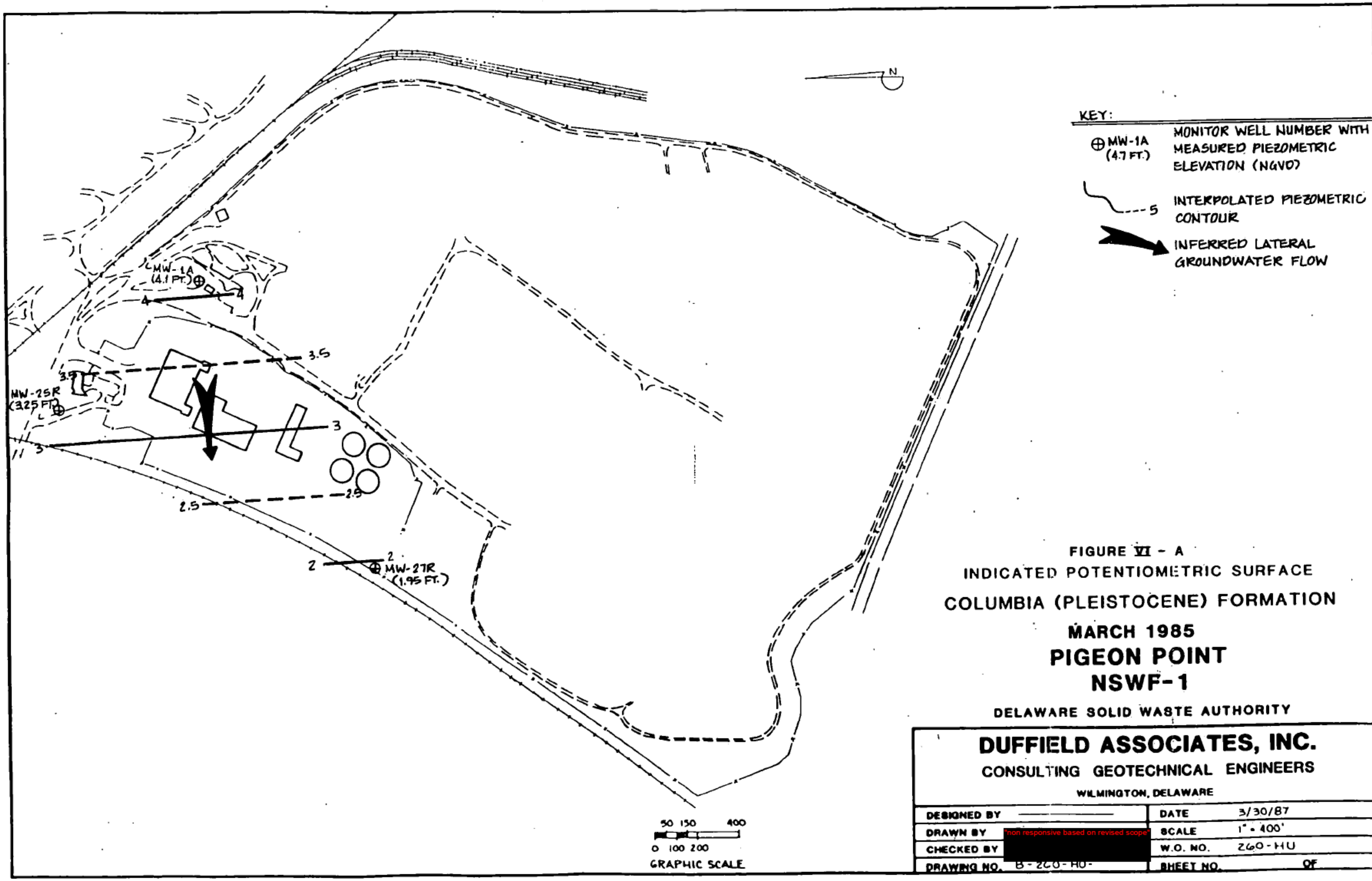
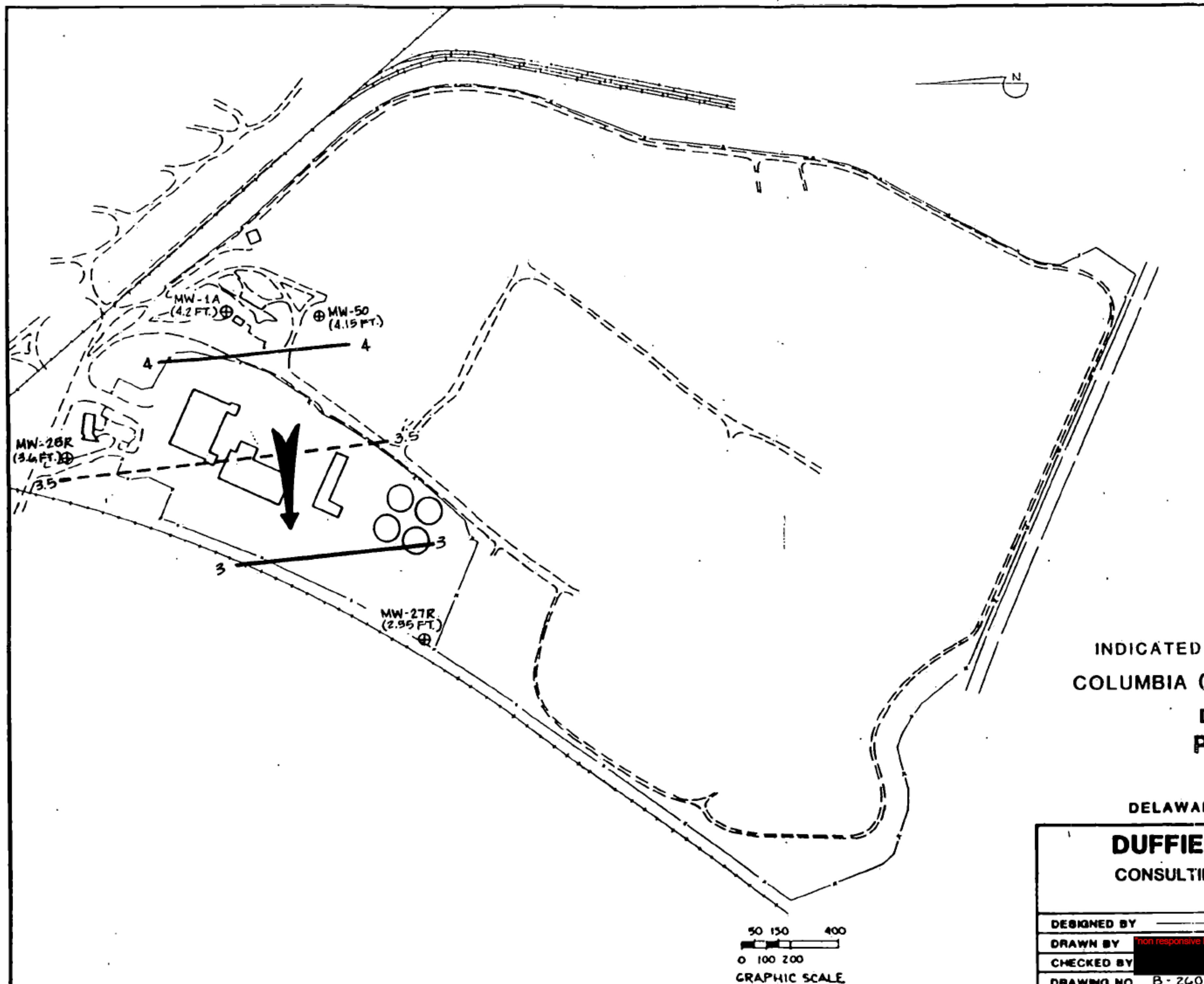


FIGURE VI - A
INDICATED POTENTIOMETRIC SURFACE
COLUMBIA (PLEISTOCENE) FORMATION
MARCH 1985
PIGEON POINT
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	[redacted]	SCALE	1" = 400'
CHECKED BY		W.O. NO.	260-HU
DRAWING NO.	B-260-HU-	SHEET NO.	OF



KEY:

⊕ MW-1A (4.7 FT.)	MONITOR WELL NUMBER WITH MEASURED PIEZOMETRIC ELEVATION (NGVD)
5	INTERPOLATED PIEZOMETRIC CONTOUR
	INFERRED LATERAL GROUNDWATER FLOW

FIGURE VI - B

INDICATED POTENTIOMETRIC SURFACE

COLUMBIA (PLEISTOCENE) FORMATION

DECEMBER 1984

PIGEON POINT
NSWF-1

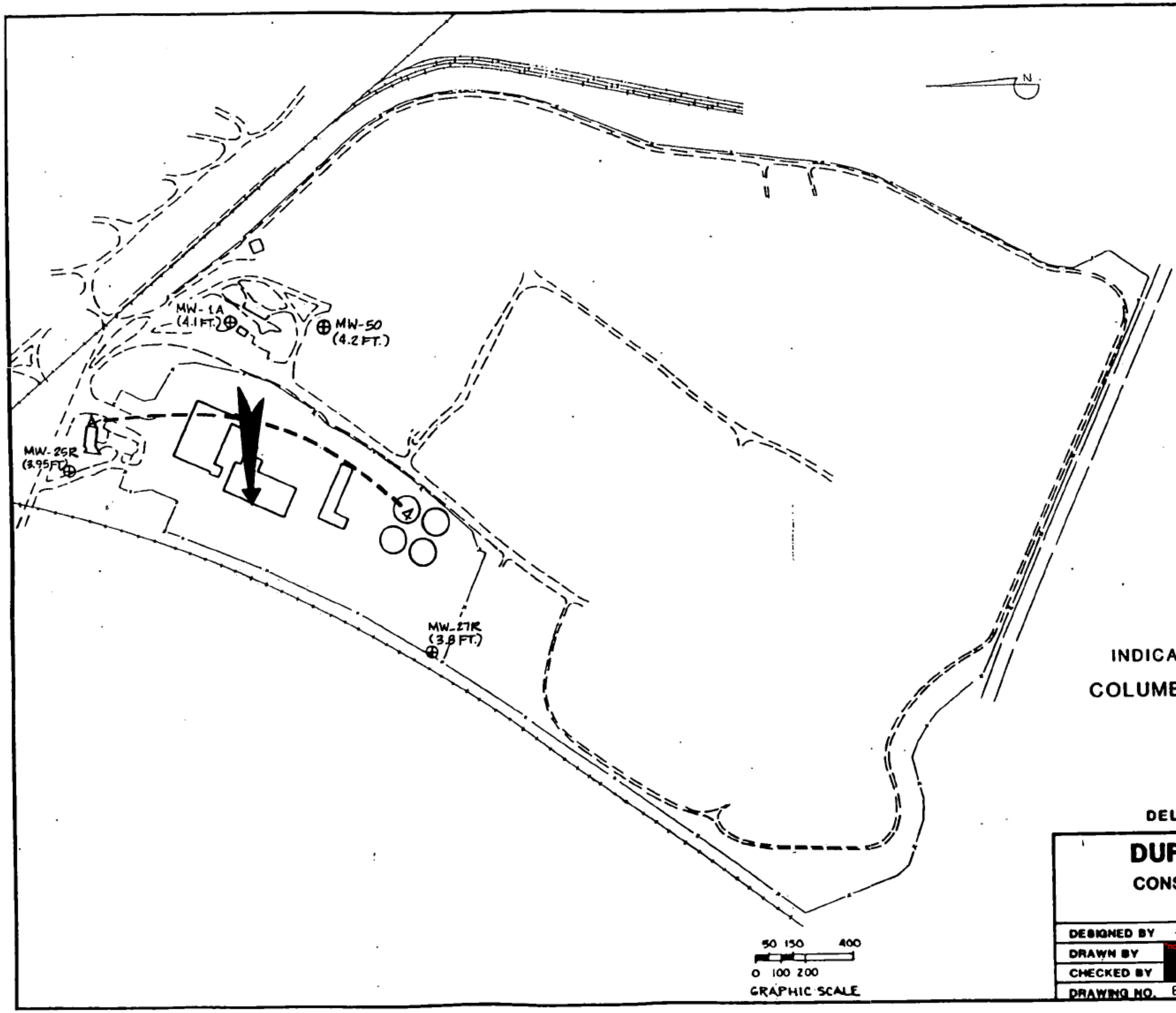
DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.

CONSULTING GEOTECHNICAL ENGINEERS

WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	[redacted] "non responsive based on revised scope"	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260-HU
DRAWING NO.	B-260-HU-	SHEET NO.	OF



KEY:

⊕ MW-1A (4.7 FT.) MONITOR WELL NUMBER WITH MEASURED PIEZOMETRIC ELEVATION (NGVD)

5 INTERPOLATED PIEZOMETRIC CONTOUR

INFERRED LATERAL GROUNDWATER FLOW

FIGURE VI - C

INDICATED POTENTIOMETRIC SURFACE

COLUMBIA (PLEISTOCENE) FORMATION

SEPTEMBER 1984

PIGEON POINT

NSWF-1

DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.

CONSULTING GEOTECHNICAL ENGINEERS

WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	"non responsive based on revised scope"	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260 - HU
DRAWING NO.	B - 260 - HU -	SHEET NO.	OF

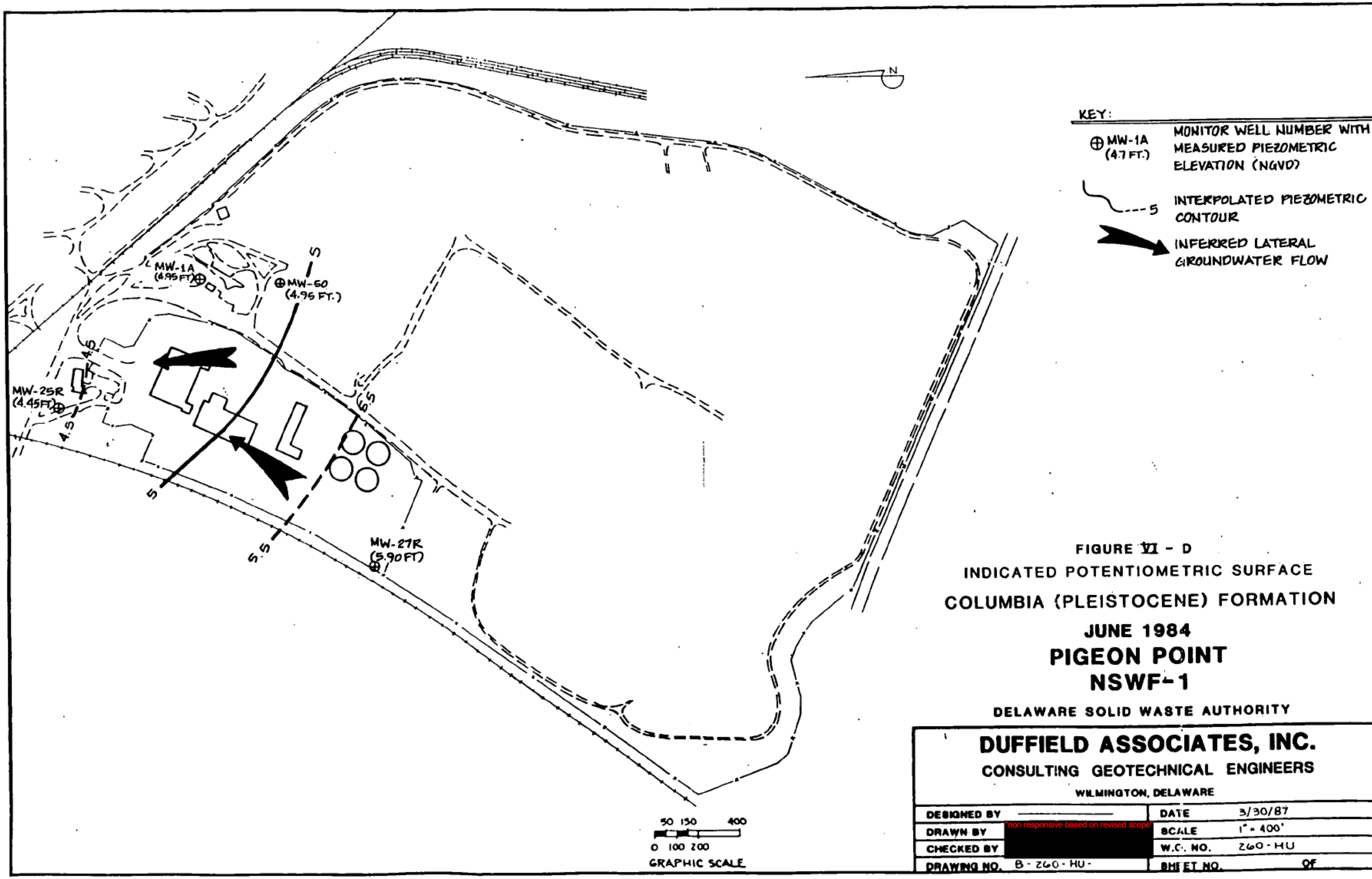


FIGURE VI - D

INDICATED POTENTIOMETRIC SURFACE

COLUMBIA (PLEISTOCENE) FORMATION

JUNE 1984

PIGEON POINT

NSWF-1

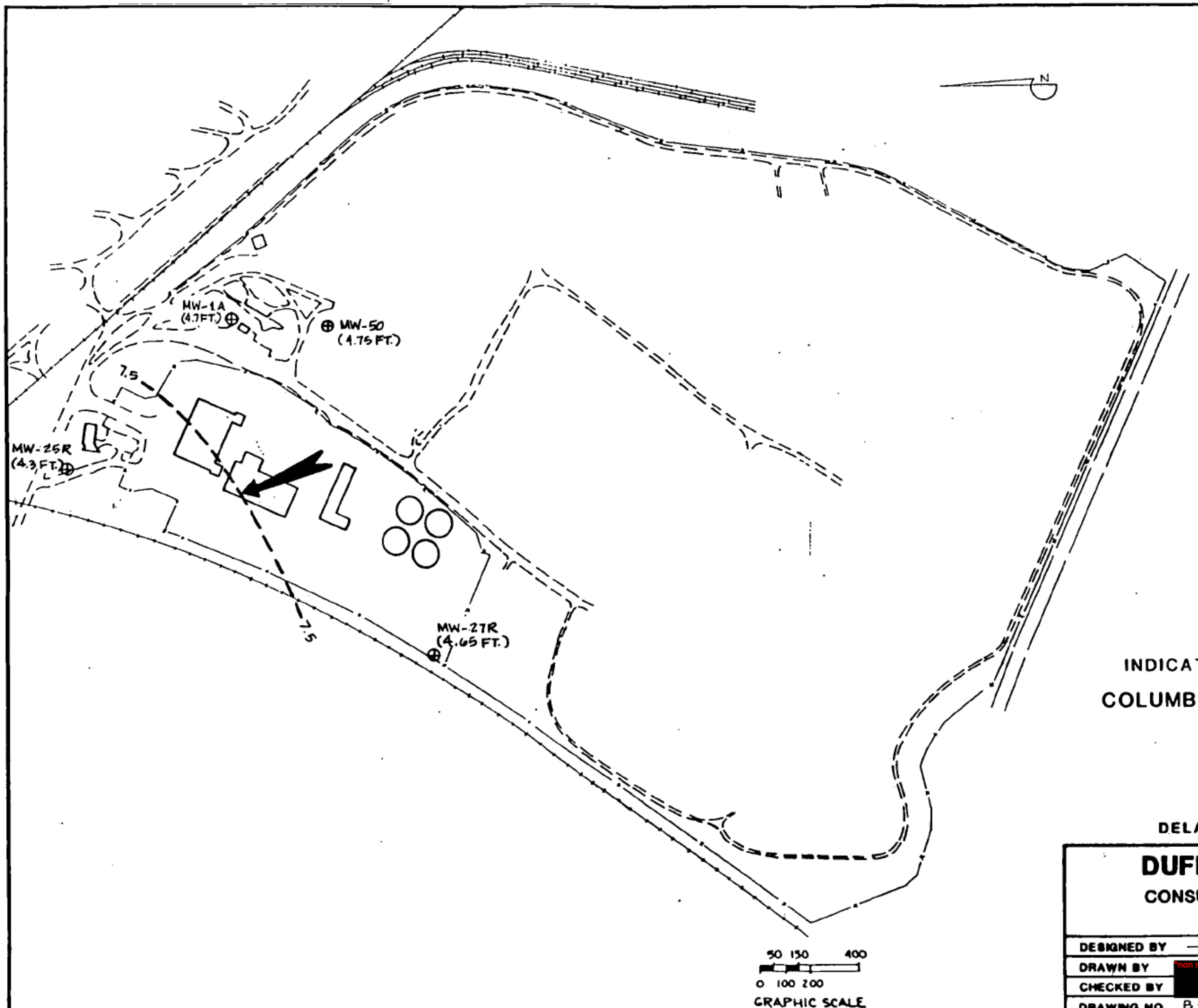
DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.

CONSULTING GEOTECHNICAL ENGINEERS

WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	non responsive based on revised scope [redacted]	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260 - HU
DRAWING NO.	B - 260 - HU -	SHEET NO.	OF



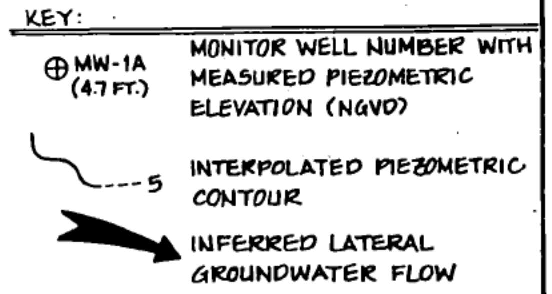


FIGURE VI - E
INDICATED POTENTIOMETRIC SURFACE
COLUMBIA (PLEISTOCENE) FORMATION
MARCH 1984

PIGEON POINT
NSWF-1

DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
WILMINGTON, DELAWARE

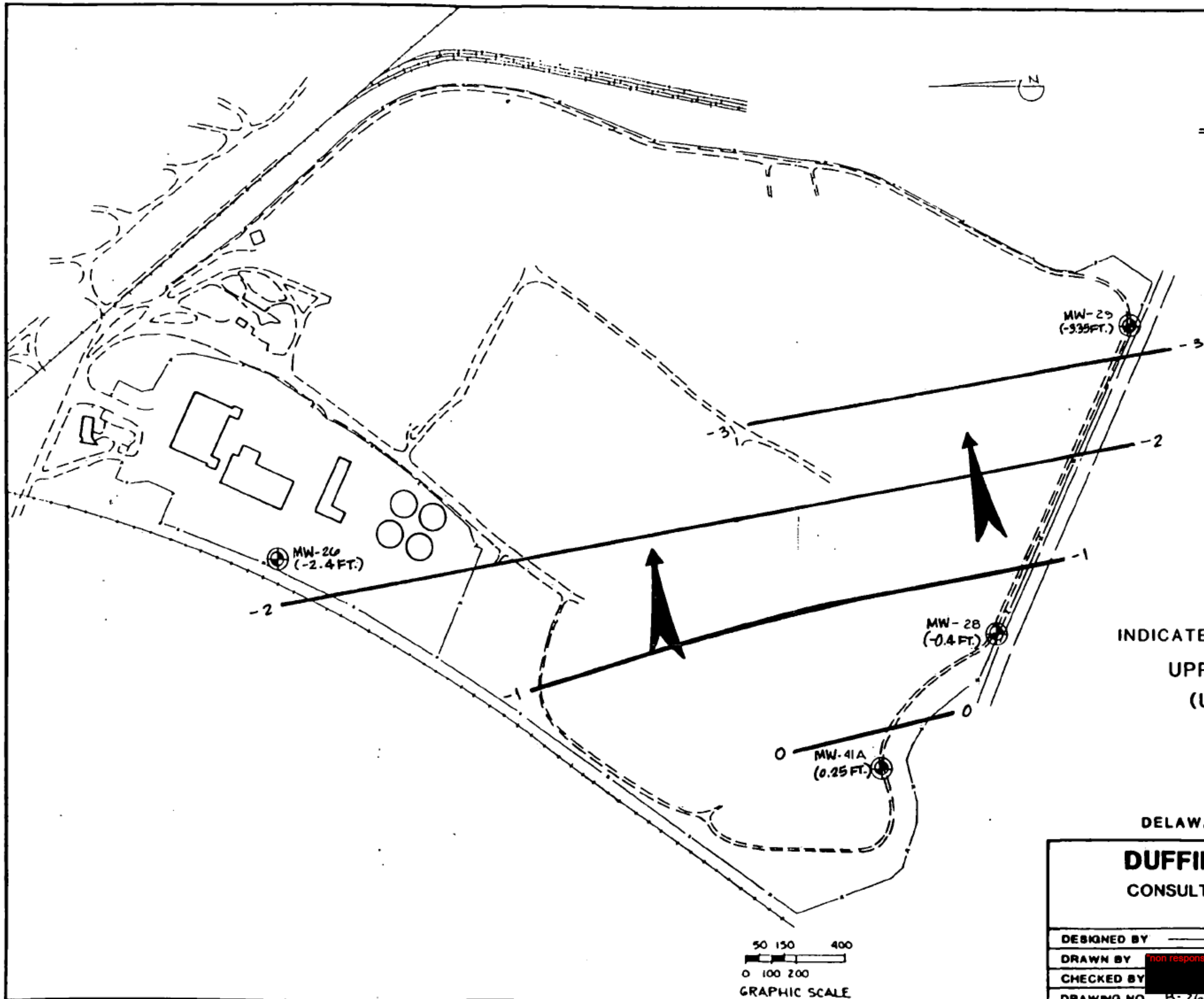
DESIGNED BY		DATE	3/30/87
DRAWN BY	[redacted]	SCALE	1" = 400'
CHECKED BY		W.O. NO.	260-HU
DRAWING NO.	B-260-HU-	SHEET NO.	OF

Figure VI. Potentiometric Surface - Columbia Formation

- A. March 1985
- B. December 1984
- C. September 1984
- D. June 1984
- E. March 1984

Figure VII. Potentiometric Surface - Upper Potomac Sand

- A. March 1985
- B. December 1984
- C. September 1984
- D. June 1984
- E. March 1984



KEY:

MW-29 (-2.05 FT.)	MONITOR WELL NUMBER WITH MEASURED PIEZOMETRIC ELEVATION (NGVD)
+1	INTERPOLATED PIEZOMETRIC CONTOUR
	INFERRED LATERAL GROUNDWATER FLOW

FIGURE VII - A

INDICATED POTENTIOMETRIC SURFACE

UPPER POTOMAC SANDS

(UNDIFFERENTIATED)

MARCH 1985

PIGEON POINT
NSWF-1

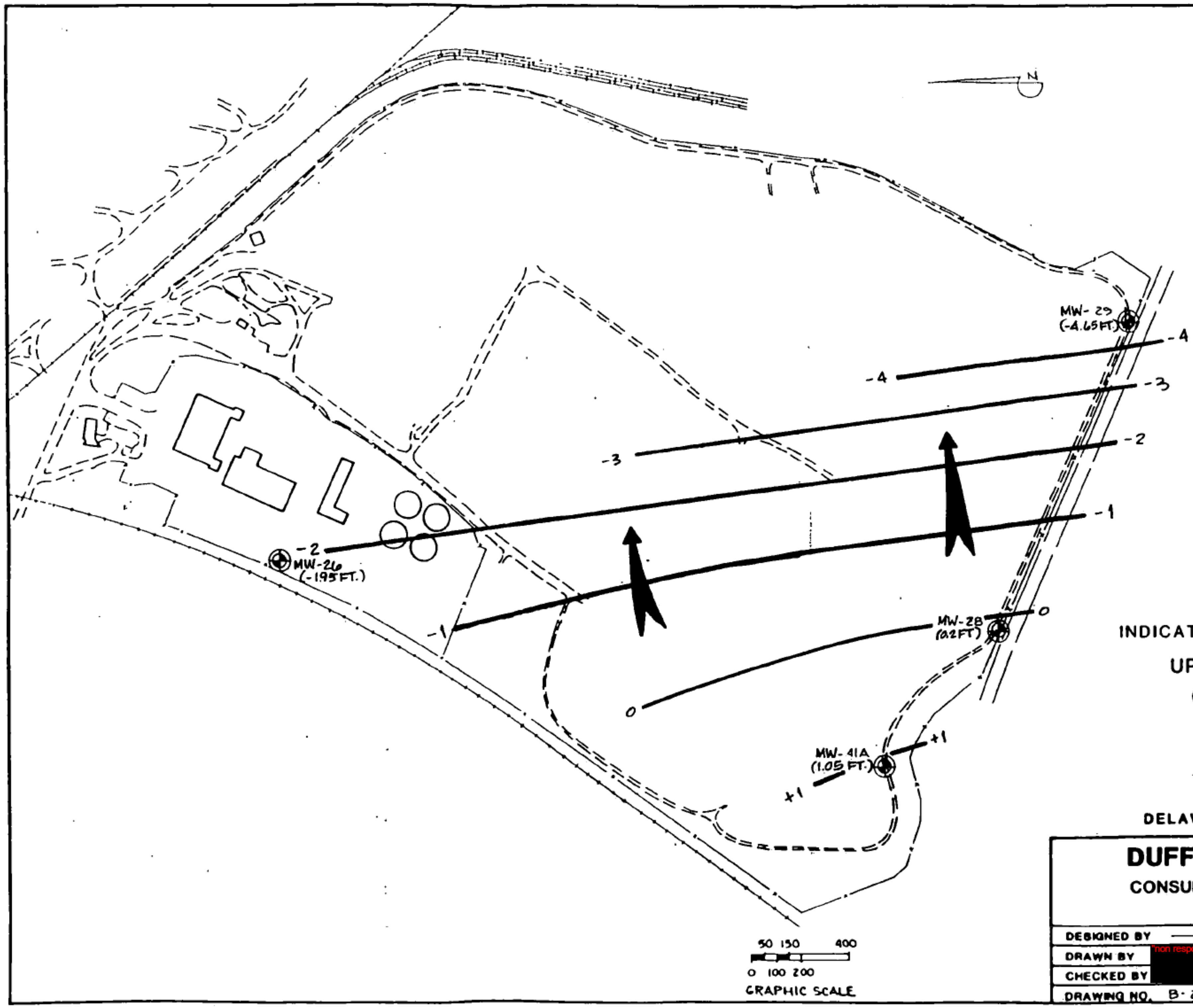
DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.

CONSULTING GEOTECHNICAL ENGINEERS

WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	non responsive based on revised scope [redacted]	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260-HU
DRAWING NO.	B-260HU-	SHEET NO.	OF



KEY:

MW-29 (-2.05 FT.) — MONITOR WELL NUMBER WITH MEASURED PIEZOMETRIC ELEVATION (NGVD)

+1 — INTERPOLATED PIEZOMETRIC CONTOUR

INFERRED LATERAL GROUNDWATER FLOW

FIGURE VII - B
INDICATED POTENTIOMETRIC SURFACE
UPPER POTOMAC SANDS
(UNDIFFERENTIATED)
DECEMBER 1984
PIGEON POINT
NSWF-1

DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	"non responsive based on revised scope"	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260-HU
DRAWING NO.	B-260HU-	SHEET NO.	OF

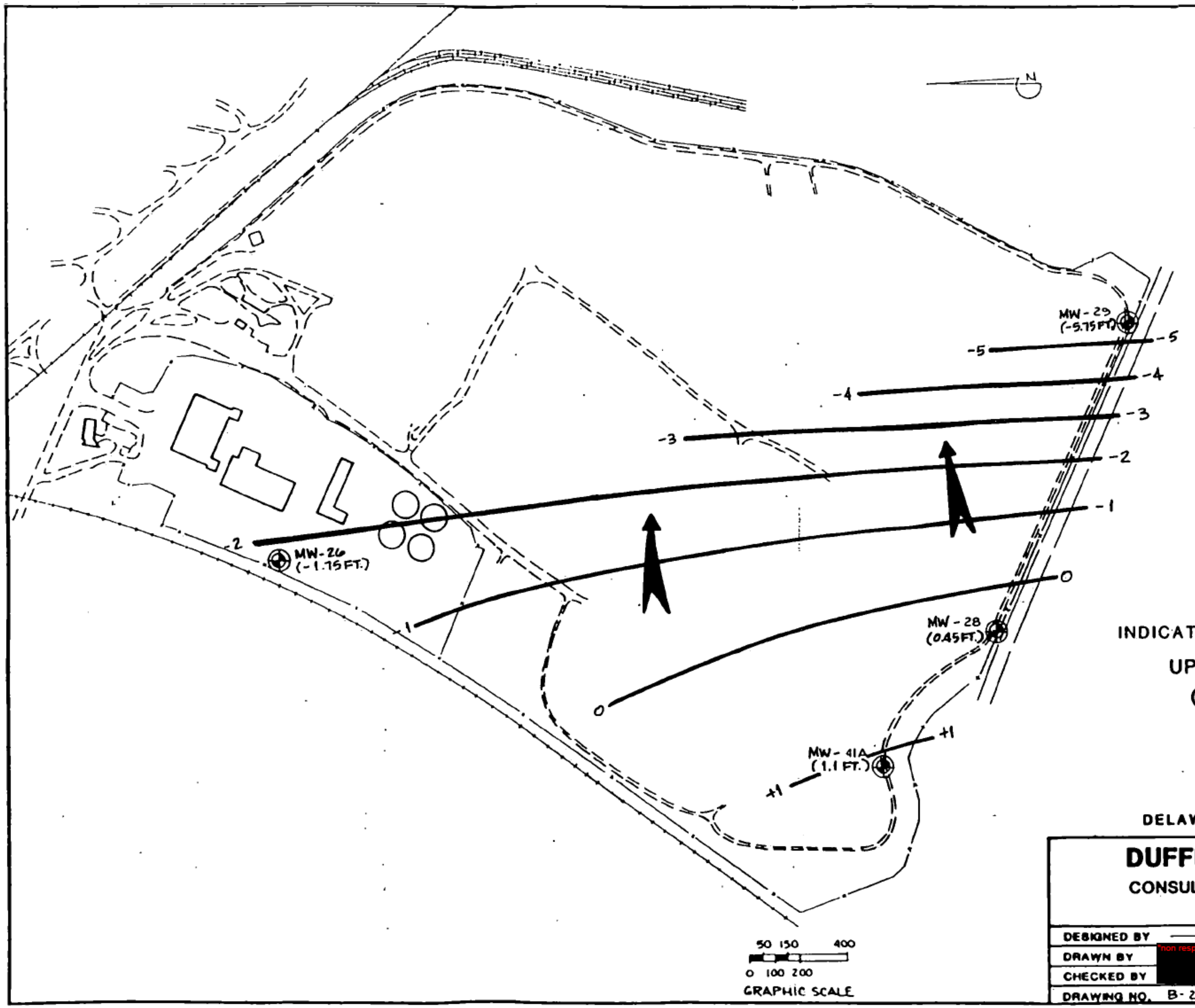


FIGURE VII - C
INDICATED POTENTIOMETRIC SURFACE
UPPER POTOMAC SANDS
(UNDIFFERENTIATED)
SEPTEMBER 1984
PIGEON POINT
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	"non responsive based on revised scope" [redacted]	SCALE	1" = 400'
CHECKED BY		W.O. NO.	260-HU
DRAWING NO.	B-260HU-	SHEET NO.	OF

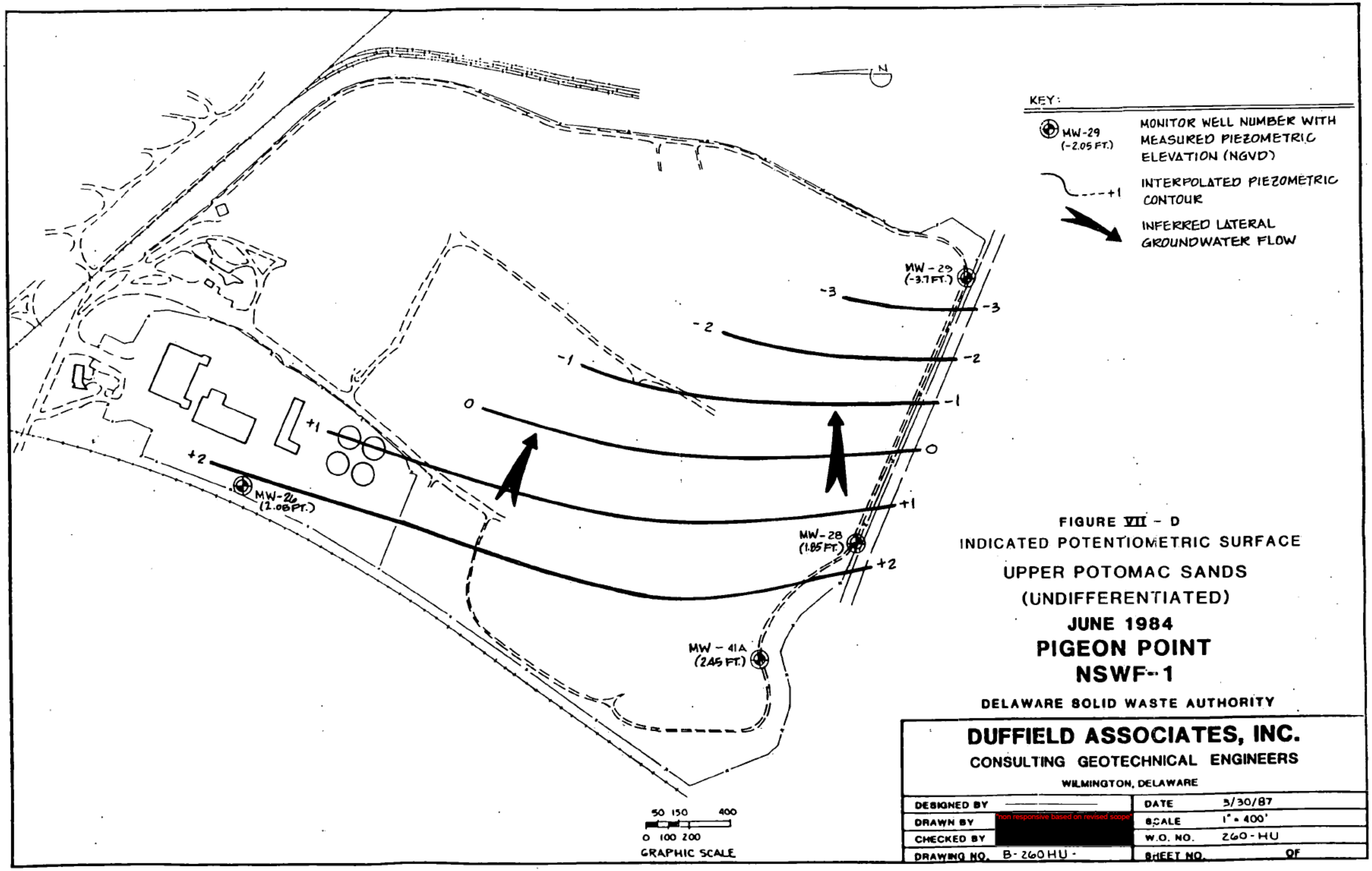
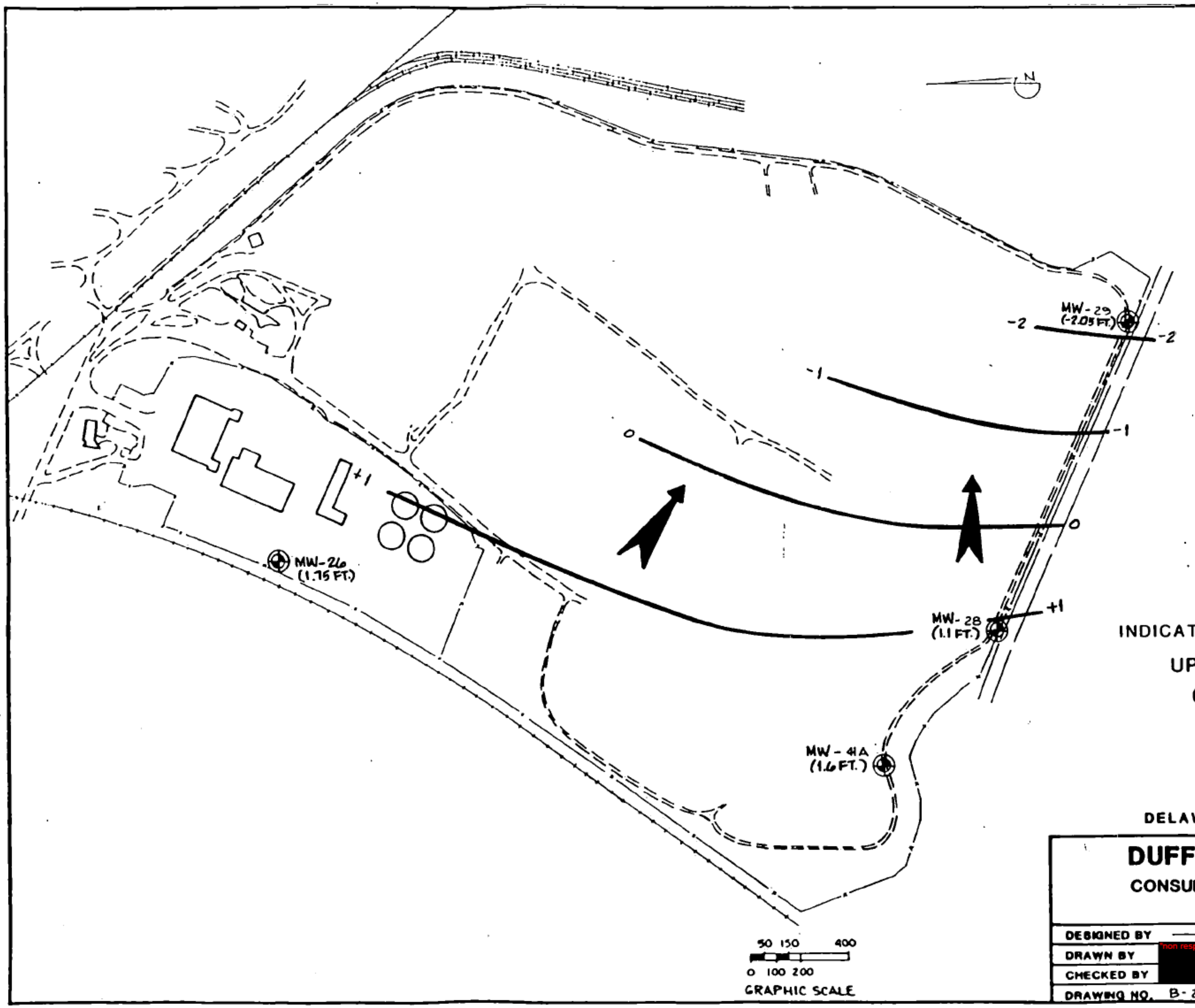


FIGURE VII - D
INDICATED POTENTIOMETRIC SURFACE
UPPER POTOMAC SANDS
(UNDIFFERENTIATED)
JUNE 1984
PIGEON POINT
NSWF-1
DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
WILMINGTON, DELAWARE

DESIGNED BY	——	DATE	3/30/87
DRAWN BY	non responsive based on revised scope [redacted]	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260-HU
DRAWING NO.	B-260HU-	SHEET NO.	OF



KEY:

MW-29 (-2.05 FT.)	MONITOR WELL NUMBER WITH MEASURED PIEZOMETRIC ELEVATION (NGVD)
+1	INTERPOLATED PIEZOMETRIC CONTOUR
	INFERRED LATERAL GROUNDWATER FLOW

FIGURE VII - E

INDICATED POTENTIOMETRIC SURFACE

UPPER POTOMAC SANDS

(UNDIFFERENTIATED)

MARCH 1984

PIGEON POINT

NSWF-1

DELAWARE SOLID WASTE AUTHORITY

DUFFIELD ASSOCIATES, INC.

CONSULTING GEOTECHNICAL ENGINEERS

WILMINGTON, DELAWARE

DESIGNED BY		DATE	3/30/87
DRAWN BY	"non responsive based on revised scope" [redacted]	SCALE	1" = 400'
CHECKED BY	[redacted]	W.O. NO.	260-HU
DRAWING NO.	B-260HU-	SHEET NO.	OF

ATTACHMENT 6

DELAWARE SOLID WASTE AUTHORITY
PIGEON POINT LANDFILL
NEW CASTLE COUNTY, DELAWARE

TREATABILITY STUDY

GROUNDWATER REMEDIATION

JUNE, 1987

CABE ASSOCIATES, INC
Consulting Engineers
144 S. GOVERNORS AVENUE
P.O. BOX 877
DOVER, DELAWARE 19903-0877
302-674-9280

SET NO. ________

DELAWARE SOLID WASTE AUTHORITY

PIGEON POINT LANDFILL

NEW CASTLE COUNTY, DELAWARE

TREATABILITY STUDY

GROUNDWATER REMEDIATION

JUNE, 1987

CABE ASSOCIATES, INC

Consulting Engineers

144 S. GOVERNORS AVENUE

P.O. BOX 877

DOVER, DELAWARE 19903-0877

302-674-9280

PROJECT NO. 128-5

TABLE OF CONTENTS

LIST OF EXHIBITS

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER I

I. CONCLUSIONS AND RECOMMENDATIONS

Of the four (4) contaminants alleged to have been released into the aquifers underlying the Pigeon Point Landfill, an enforceable drinking water standard has been promulgated only for arsenic. Non-enforceable drinking water contaminant goals have been promulgated for benzene and proposed for ethylbenzene. Although no enforcable standard has been proposed or promulgated, a health advisory has been issued for the presence of tetrachloroethylene (PCE) in drinking water and a provisional acceptable daily intake level has been set for ethylbenzene.

Although treatment technologies exist for the removal of arsenic, benzene, ethylbenzene and tetrachloroethylene from recovered groundwaters, the need for their implementation at the Pigeon Point Landfill is clearly unfounded as concluded in this report and as reported by others[1]. Inconsistent water sample analyses and a misinterpretation of the existing data bases seemingly provided the basis for placing the Pigeon Point Landfill on the National Priorities List.

In general, it would appear that application of treatment technology at the Pigeon Point Landfill is inappropriate at this time. Further sampling of the site monitoring wells is required so that the status and extent of groundwater contamination orginating from the Pigeon Point Landfill, if any, can be established.

INTRODUCTION

CHAPTER II

II. INTRODUCTION

A. Description of Problem and Scope of Study

From 1981, the Delaware Solid Waste Authority (DSWA) operated the Pigeon Point Landfill, located in New Castle County, Delaware. The landfill was closed in 1985. After reviewing a document prepared by NUS Corporation(2), the Environmental Protection Agency (EPA) recommended that the landfill be placed on the National Priority List of Hazardous Waste Sites. The NUS study asserted that four (4) contaminants - benzene, ethylbenzene, tetrachloroethylene and arsenic - had been released from the landfill into underlying aquifers utilized for public drinking water. A subsequent study performed by Duffield Associates, Inc. of Wilmington, Delaware determined that an "observed release" of these contaminants from the Pigeon Point Landfill did not actually occur. (1)

The purpose of this treatability study is threefold. First, the study will outline the treatment system requirements in light of both existing water quality data and the applicable regulations for obtaining a high quality drinking water from the recovered groundwater. Then, appropriate treatment alternatives capable of attaining a water quality equal or better than that required by drinking water regulations will be evaluated. Lastly, the need for implementation of a groundwater recovery treatment system for the DSWA Pigeon Point Landfill will be discussed.

B. Relevant Experience of CABE Associates, Inc.

CABE Associates, Inc. has performed treatability studies, facilities planning, facilities design, construction and operation for numerous private and public water supply systems. Paralleling the rapidly growing public and regulatory concern over the quality of drinking water, numerous recent projects have been concerned with remediating groundwater contaminated with synthetic organic compounds (SOCs) and inorganic compounds (IOCs). Some of the project experience most pertinent to this study are as follows:

1. Piloted, evaluated, designed and provided inspection services for the installation of a granulated activated carbon treatment system for removal of trichloroethylene (TCE) and other trace volatile organics in the water supply system of the Town of Smyrna, Delaware.

2. Initial site evaluation, design engineering, construction and operation and maintenance for remediation of a recovered groundwater containing relatively high concentrations of volatile organic compounds (VOCs) at the former Chem Solv operation located at Cheswold, Delaware.

3. Formulation of process, design and assistance in implementing a treatment system for an industrial client remediating an on-site groundwater contaminated with a wide variety of VOC's.

4. Evaluation of treatment and disposal alternatives for leachate from Tybout's Landfill, New Castle, Delaware.

5. Performed a treatability study and formulated a treatment and disposal system for water pumped from recovery wells intended to prevent leachate migration to an existing water supply well field near Army Creek, New Castle, Delaware.

TREATMENT REQUIREMENTS

CHAPTER III

III. TREATMENT REQUIREMENTS

A. Treatment Requirements Dictated by Water Quality

Monitoring wells located across the Pigeon Point Landfill (as shown in Exhibit III-1) have provided data on groundwater quality. The available monitoring well water quality data has been interpreted conflictingly by others.[1][2] However, to adequately address treatment requirements, the level and extent of contamination which exists in the aquifers underlying the Pigeon Point Landfill must be accurately determined. Therefore, the monitoring well water quality data needed to be reevaluated.

1. Site Geology and Hydrogeology

An understanding of subsurface conditions is crucial to understanding the extent of groundwater contamination. Subsurface geology and hydrogeology is discussed in depth by Duffield [1] and to some extent by NUS [2] and is summarized and discussed further below:

The Pigeon Point Landfill is underlain with a 12 foot thick liner composed of marsh dredge spoils. A deposit of soft highly plastic silts and clays of varying thickness (0 to approximately 60 feet deep), called the Recent deposit, underlies the landfill spoils liner. The Columbia Aquifer, composed of gravely fine and medium sands with interbedded silts and clays, apparently underlies the landfill liner and Recent deposits only at the northern portion of the site.[1] A deeper aquifer called the Potomac Aquifer and composed of variegated silt and clay deposits with interbedded sands extends from the overlying formations (Columbia, Recent and/or liner) to the bedrock underlying the site.

Monitoring wells are used to sample the water quality of groundwater in the various formations defined above. These wells are located as shown in Exhibit III-1, with the formations they sample also identified.

Groundwater flow potentials in the Potomac and Columbia aquifers can be inferred by examining the piezometric data from the site monitoring wells as shown in Exhibit III-2. Examination of the data for all the Potomac wells indicates a southeastern groundwater flow direction for the Potomac aquifer, as reported by NUS(2). However, if (as Duffield indicates) monitoring well No. 31 is screened in a hydrogeologically impeded sand lens and if monitoring Well No. 45 is screened in a hydrogeologically separate zone in the Potomac aquifer, a more easterly groundwater flow would occur in the Potomac aquifer, as Duffield(1) reports. Until other data on subsurface conditions becomes available, it will be sufficient for this report to state that the piezometric data indicates an easterly to southeasterly flow direction in the Potomac aquifer and that Wells No. 26R, 28, 41A and 45 are upgradient Potomac wells whereas Well No. 29 is a downgradient Potomac well.

Evaluation of the piezometric data for the Columbia wells reveals a westerly flow direction for the Columbia aquifer, with flow directions shifting from the northwest (as indicated in the 1983/84 data) to the southwest (as indicated in the 1987 data). CABE therefore concurs with Duffield's assertion of a westerly flow direction in the Potomac aquifer as opposed to the NUS assertion of a southeasterly flow direction for both the Columbia and Potomac aquifers. NUS's misinterpretation of flow potential data led to an apparently incorrect conclusion that Columbia Well No. 27R was an upgradient Columbia well. The piezometric data indicates clearly that Well 27R is a downgradient Columbia aquifer well, and that Wells 1A and 25R are upgradient Columbia wells.

2. <u>Water Quality Analyses Results</u>

The NUS Study recommended that the Pigeon Point Landfill be placed on the National Priorities Listing based on an assumed "observed release" of four (4) contaminants: Arsenic, Benzene, Ethylbenzene and Tetrachloroethylene (PCE). These contaminants were alleged to be migrating through the dredge spoils landfill liner and into the underlying Columbia and Potomac aquifer formations. The basis of this assertion was that the contaminants were first detected in the mid site monitoring wells (#46, 47, 48 and 49) which were screened in the dredge spoils and then, at a later date, the contaminants were detected in the "downgradient" monitoring wells (25/25R, 27/27R, 28, and 29) which are screened in the aquifers underlying the site. However, the water quality data clearly does not support the assertion that a release has occurred from the landfill for the reasons detailed as follows:

a. The existing groundwater quality data has no continuity and suggests that analytical errors are the cause of the observed contaminant concentration spikes upon which "release" was evidenced in the NUS study.

b. Contrary to what would be expected, no daughter compounds of VOC's were detected in the monitoring wells.

c. The assumed "observed releases" of contamination did not occur in a manner typical of landfill contaminate releases.

As pointed out previously, monitoring wells 25R and 28 are <u>upgradient</u> monitoring wells and most clearly indicate background water quality. Monitoring wells No. 46 through 49 are screened in the base of the landfill, and water quality data for these wells establish only the presence of contaminants in the landfill leachate. Therefore, water quality data for wells No. 25R, 28, 46, 47, 48, and 49 do not directly indicate that a release from the landfill has occurred.

Benzene was alleged to have been released from landfill based on its detection in Wells No. 27R and 28 at a concentration level of 1 ppb and 1.5 ppb respectively. For VOCs such as benzene, the Environmental Protection Agency (EPA) recognizes that one part per billion (ppb) is the concentration level which can be measured with 99% confidence that the true value of the contaminant concentration measured is greater than zero. In setting drinking water standards, the EPA stated that 5 ppb is the Practical Quantitation Level (PQL), defined as the level of detection achievable by most analytical labs using good lab practices.(3) EPA's performance evaluation of experienced labs testing standard samples without sample interferences from other contamiants revealed an analytical detection failure of 10 to 30 percent even in the test range of 5 to 20 ppb. The wide variability of groundwater quality sampling results and the potential for error was no doubt the impetus behind EPA allowing potable water suppliers to report IOC and SOC contamination in water supplies to the public only after the average of four (4) water quality tests taken over a 30 day period indicates the presence of a contaminant in excess of its allowable concentration.(11) Therefore, the assertion that an "observed release" of benzene occured based on its "detection" at concentration levels less than 5 ppb therefore seems questionable, especially in light of other analytical problems discussed below.

The water quality analyses results reported for arsenic also seem suspect. Arsenic was undetected at concentration levels above 12 ppb for the four (4) year period prior to its sudden detection in both the upgradient (28) and downgradient (29) Potomac Aquifer monitoring wells and was undetected in the two (2) years following its sudden detection in both the Potomac Aquifer monitoring wells as shown in Exhibits III-5 and III-6. Arsenic was not detected in the Columbia Aquifer monitoring wells. The very brief period of detection of arsenic in the Potomac wells is inconsistent considering its history of nondetection. As reported by others[1], the observed arsenic "peaks" seem to represent aberrations in the data, probably attributed to faulty sampling and/or laboratory analyses.

The lack of continuity in the groundwater data is also evidenced in the analysis of water quality reporting for PCE. A release of PCE from the landfill was alledged to have occurred based upon its detection at a concentration level of 9000 parts per billion (ppb) in March of 1984 in Monitoring Well 25, and at a concentration level of 150,000 ppb and 100 ppb in Monitoring Wells No. 27 and 28, respectively, in September of 1984. However, time plots of PCE concentrations detected in Monitoring Wells 25, 27 and 28 (see Exhibits III-3 through III-5) indicate only these very large spikes of PCE detected, and each spike is followed by long periods of nondetection. Like the alleged detection of arsenic described above, the sudden appearance of a very large spike of PCE contamination at levels over a thousandfold higher than normally found is inconsistent with the general observation of nondetection in the wells. As pointed out by others[1], the PCE peaks appear and disappear suddenly in the monitoring record and occur simultaneously with the detection of PCE in the interior leachate wells and in the leachate collection system. The Duffield assertion that the PCE peaks reflect an aberration of the data therefore seems warranted.

Further evaluation of the water quality data reveals another inconsistency with regards to PCE. Anaerobic bacteria found naturally below ground degrade PCE using the following pathway:

$$\text{Tetrachloro-ethylene} \longrightarrow \text{Trichloro-ethylene} \longrightarrow \left\{\begin{array}{l}\text{cis 1,2, dichloroethane}\\ \text{trans 1,2 dichloroethlyene}\\ \text{1,1 dichloroethane}\end{array}\right. \longrightarrow \text{Vinyl chloride}$$

However, excluding its detection at 1.5 ppb in upgradient Potomac Monitoring Well No. 28, trichloroethylene (TCE) was not detected in any of the monitoring wells after detection of the PCE spike in March and September of 1984. The detection of TCE in Monitoring Well No. 28 at a concentration level close to the theoretical analytical detection level for volatile organic compounds (VOCs) and then never again probably reflects analytical lab errors. The fact that no daughter compounds of PCE were found suggests that no PCE was present to begin with.

The fact that compounds were detected singly and not in combination usually indicative of landfill releases points strongly to the possibility that analytical errors occured. For example, when arsenic was detected in both upgradient (28) and downgradient (29) Potomac Aquifer monitoring wells, no other contaminants of concern were detected in either the Potomac Aquifer monitoring wells. Likewise, no other contaminants of concern were detected during the alledged release of PCE in September of 1984.

It would not be good engineering practice to predicate design of a treatment system on inconsistent and probably inaccurate laboratory water quality data reports. The above evaluation of water quality data indicates that the concentration spikes detected for benzene, PCE and arsenic can probably be attributed to sampling and/or analytical errors. Therefore, this report will develop and discuss those treatment options able to remove maximum detected contaminant concentration levels excluding the highly suspect peak concentrations reported in 1984 and 1985 for PCE and arsenic.

B. Regulatory Requirements

As stated previously, the Pigeon Point Landfill was recommended for inclusion on the National Priorities List for uncontrolled hazardous waste sites based on an assumed "observed release" of four (4) contaminants from the landfill. Of particular concern was that the assumed "releases" occurred into aquifers serving as water supply sources for nearby publicly and privately owned water utilities. Therefore, if the assumed observed release into the aquifers underlying the landfill site has occured, then groundwater recovered from the aquifers and utilized as a water supply source would be required to meet National Drinking Water criteria for the contaminants of concern.

The Safe Drinking Water Act (SDWA) empowers the Environmental Protection Agency (EPA) with the authority to set acceptable concentration levels for contaminants in the drinking water supplied by both public and private water utilities. The regulatory approach taken by the EPA has been to set both a maximum contaminant level (MCL) and a maximum contaminant level goal (MCLG) for the concentration of various contaminants found in drinking water. The MCLG is a nonenforceable standard set at the concentration level at which no ill effects upon human health can be expected, while the MCL is an enforceable standard set at a concentration level as close as possible to the MCLG and which can cost effectively be attained through the use of best available technology (BAT).

The following proposed and promulgated contaminant levels in parts per billion (PPB) have been set for the contaminants under study as detailed below:

Constituent	MCL (PPB)	MCLG (PPB)
Arsenic	50	50 (Proposed)
Benzene	5 (Proposed)	0
Ethylbenzene	NP (Not Proposed)	680 (Proposed)
Tetrachloroethylene	NP	NP

As the above table shows, neither a MCL nor a MCLG have been proposed for tetrachloroethylene (PCE), nor have MCLs or MCLGs been promulgated for most of the other contaminants under study. However, the EPA is required under the 1986 SDWA amendments to promulgate both MCLs and MCLGs for most VOCs, including PCE and those VOCs with proposed MCLs and MCLGs listed in the table above, within the next three (3) years. The US office of Drinking Water has issued a Health Advisory limit of 20 ppb for the long term exposure to PCE in drinking water and it is doubtful that the final promulgated MCL for PCE will exceed this limit. Also, a provisional Acceptable Daily Intake (ADI) for ethylbenzene has been set at 3400 ppb, and the final MCL will probably not exceed that limit.

As stated previously, MCLs are the enforceable standards for drinking water. Therefore, this study will evaluate the treatment alternatives capable of treating recovered groundwater to either proposed or promulgated MCL levels, which as the above chart shows exist only for arsenic and benzene. Since MCLs have not been set for ethylbenzene and PCE, this study will also evaluate treatment alternatives capable of attaining treatment system effluent concentration levels at the ADI level of 3400 ppb for ethylbenzene and the Health Advisory limit of 20 ppb for PCE.

C. Treatment System Design Parameters

The treatment system required for removal of contaminants from the aquifers underlying the Pigeon Point Landfill must be able to treat the maximum contaminant concentrations found in the recovered groundwater, excluding inconsistent contaminant concentration spikes as discussed above, to attain contaminant concentrations in the treatment system effluent at the regulatory or advisory contaminant levels described in the text of the report above. However, as Exhibits III-3 through III-6 show, maximum detected contaminate concentrations are generally observed to be peak values followed and/or preceeded by long periods of nondetection. Average treatment system influent concentrations can be expected to be at or slightly above the theoretical limits of detection (approximately 1 PPB). Predicating design of a treatment system upon these "maximum expected" values, which may themselves represent analytical errors, is at best a conservative approach. Further testing of groundwater quality is needed to establish the validity of detection of these maximum contaminant concentration values.

Treatment system parameters are tabulated as follows:

Contaminant	Maximum Influent Concentration Expected	Advisory and/or Regulatory Treatment System Effluent Level
Arsenic	12	50
Benzene	3	5
Ethylbenzene	9	3400
PCE	9	20

As the above chart shows, maximum expected treatment system influent concentrations (as well as average influent concentrations) are well below treatment system effluent concentration levels advised or set by regulation. Average treatment system influent concentration levels would be well below the concentration levels which can be reliably detected by most analytical labs (5 PPB). It may therefore be impossible to analytically establish that a reduction in concentration of contaminants has occurred within the treatment system.

EXHIBIT

cabe
128-5
JUNE, 1987
128A-001

SITE PLAN
PIGEON POINT LANDFILL

EXHIBIT
III-1

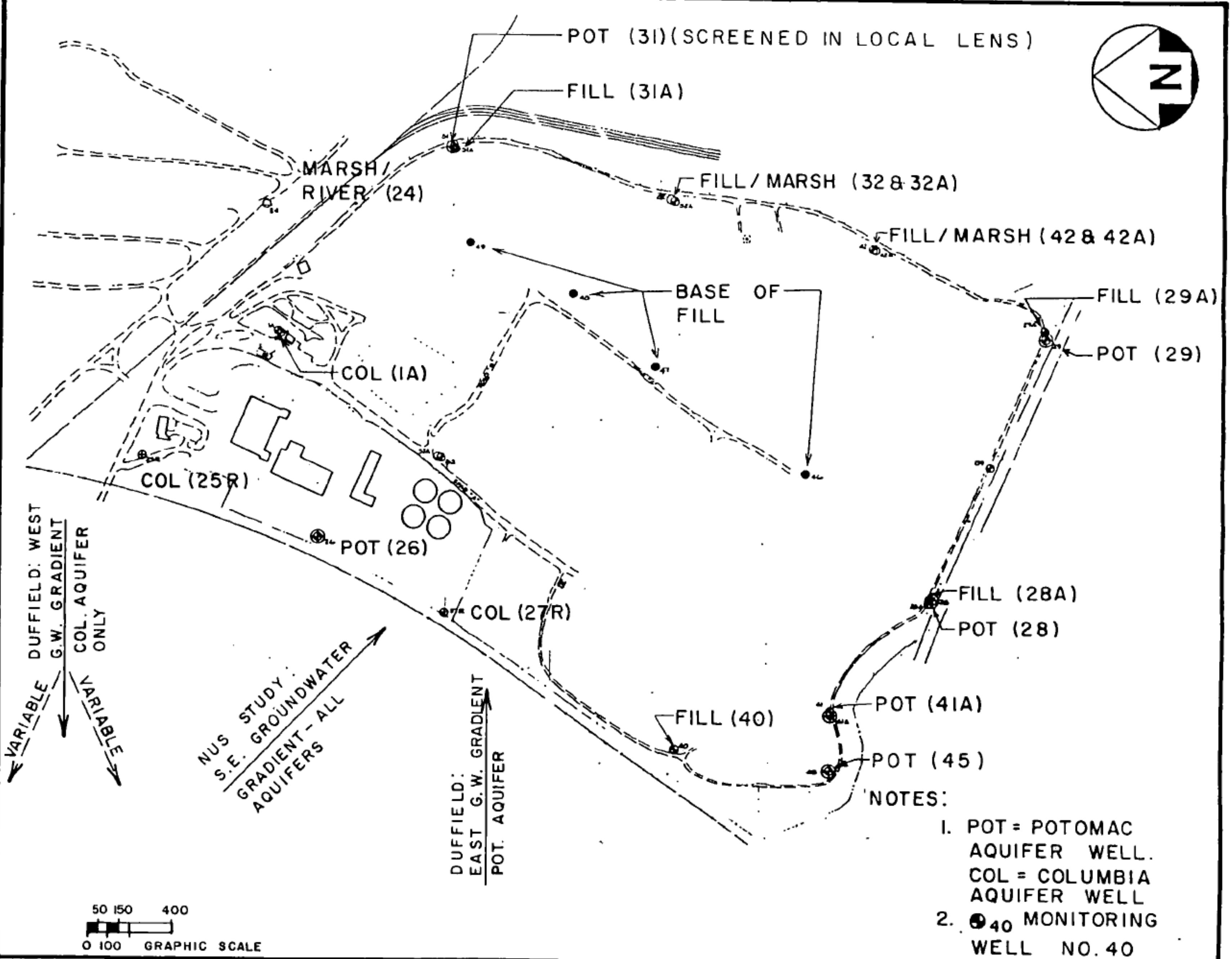


EXHIBIT III-2
MEASURED PIEZOMETRIC ELEVATIONS FOR
GROUNDWATER MONITOR WELLS
AT PIGEON POINT LANDFILL

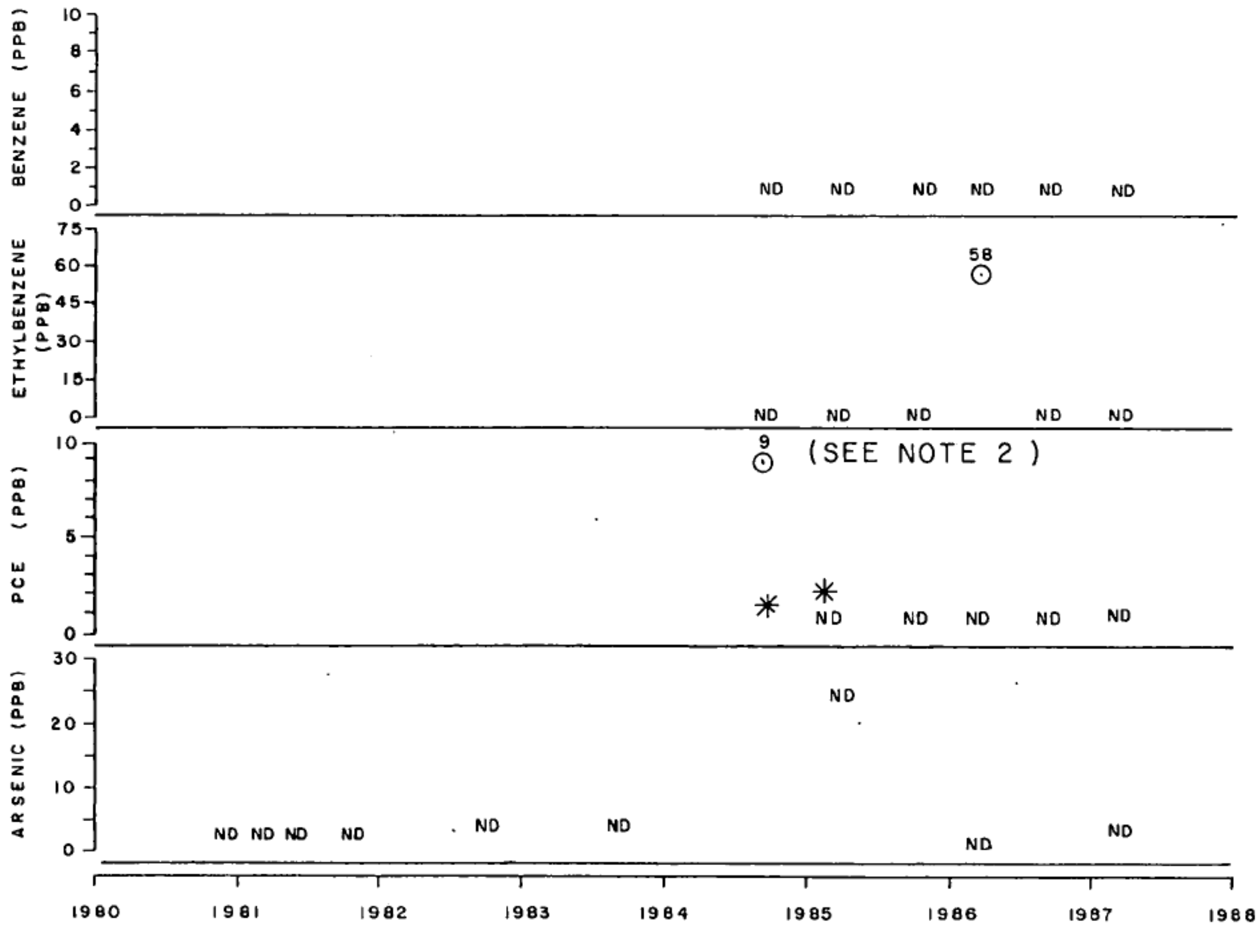
MONITOR	1987	1986				1985				1984				1983			
WELL NO.	MARCH	DEC	SEPT	JUNE	MARCH	DEC	SEPT	JUNE	MARCH	DEC	SEPT	JUNE	MARCH	DEC	SEPT	JUNE	MARCH
COLUMBIA																	
1A	5.15	5.20	4.00	4.35	5.45	5.20	4.45	4.15	4.10	4.20	4.10	4.95	4.70	5.35	4.15	5.25	4.50
25R	4.50	4.45	3.10	3.50	4.10	3.45	2.60	2.75	3.25	3.60	3.95	4.45	4.30	4.50	3.90	4.45	3.80
27R	5.20	5.15	1.65	2.35	3.40	1.80	0.75	1.00	1.95	2.55	3.80	5.90	4.65	4.95	4.10	5.60	2.65
50																	
POTOMAC																	
26R	2.15	2.75	-1.35	-1.15	-0.85	-0.70	-3.20	-2.75	-2.40	-1.95	-1.75	2.05	1.75	0.80	1.60	2.30	-0.30
28	0.80	0.10	-0.55	0.10	0.80	0.00	-0.90	-0.10	-0.40	0.20	0.45	1.85	1.10	0.50	0.35	2.05	-0.10
29	-4.30	-5.10	-5.15	-4.20	-3.35	-11.90	-5.60	-5.35	-3.35	-4.65	-5.75	-3.70	-2.05	-2.85	-4.10	-2.90	-2.10
31	4.20	4.05	3.60	4.15	4.70	-5.10	4.05	3.55	2.85	3.40	3.70	4.10	4.00	3.75	3.75	4.50	4.10
41A	1.40	2.30	0.05	0.70	1.40	-0.40	-0.35	0.40	0.25	1.05	1.10	2.45	1.60	0.90	1.10	-0.25	0.15
45	-1.20	0.60	-5.90	-6.55	-4.70	-8.15	-8.70	-7.80	-8.00	-7.44	-8.95	-0.98	-2.40	-2.90	-1.76		

NOTES:
1) PIEZOMETRIC ELEVATION WERE DETERMINED BY MEASURING DEPTH TO GROUNDWATER, REFERENCED TO TOP OF CASING ELEVATION.
2) ALL ELEVATIONS BASED ON N.G.V.D. (1929 SEA LEVEL DATUM).

cabe
128-5
JUNE, 1987
128A-002

MONITOR WELL 25/25R
PIGEON POINT LANDFILL

EXHIBIT
III-3



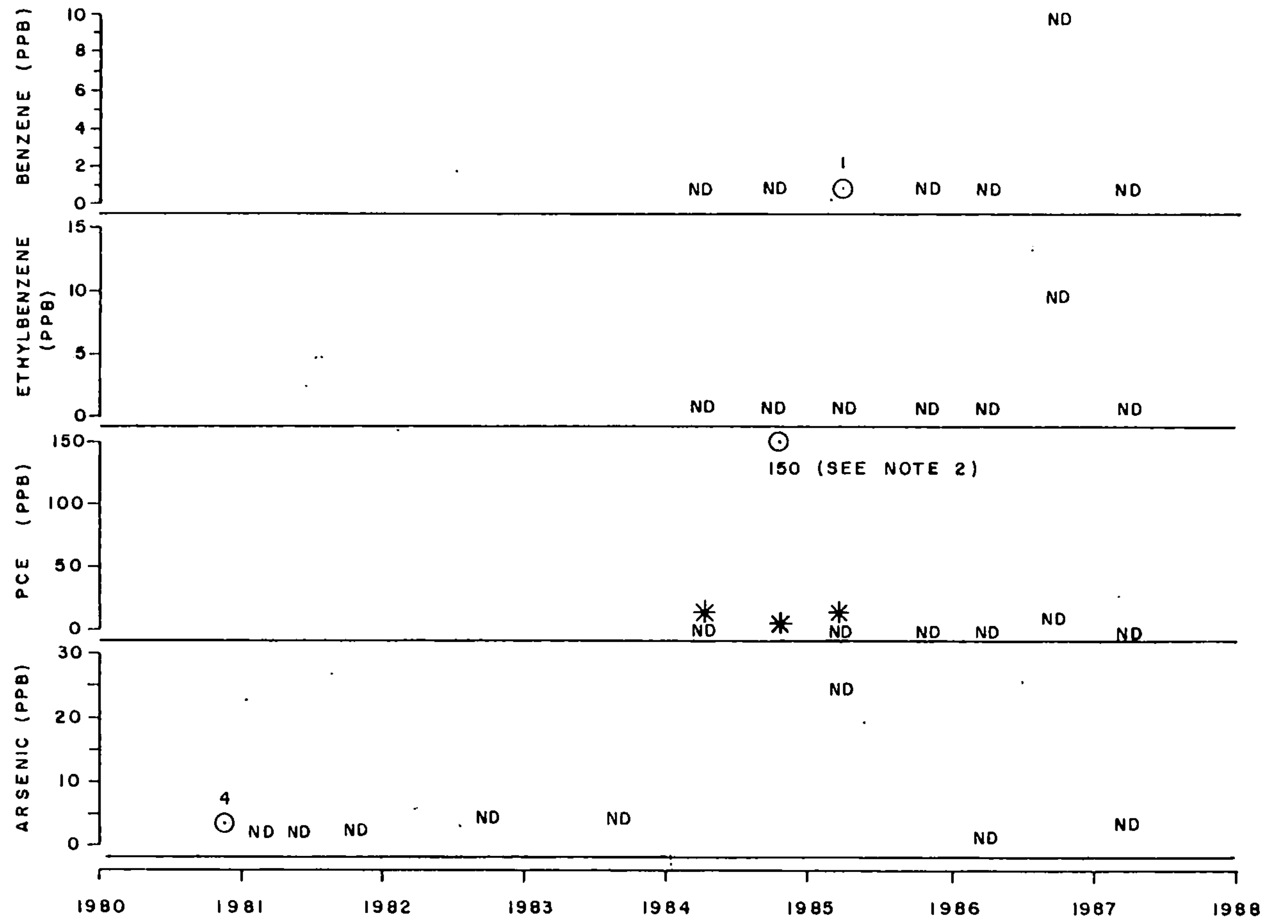
NOTES:

1. ND - NOT DETECTED (LIMIT OF ANALYTICAL DETECTION)
2. FOR SEPT., 1984 ANALYSES, VOC'S ARE REPORTED AS PPM IN REF #16 OF NUS REPORT, AS PPB IN DUFFIELD REPORT
3. ✳ = TCE NOT DETECTED
4. ⊙ = DETECTED CONCENTRATION

MONITOR WELL 27/27R
PIGEON POINT LANDFILL

cabe
128-5
JUNE, 1987
128A-003

EXHIBIT III-4

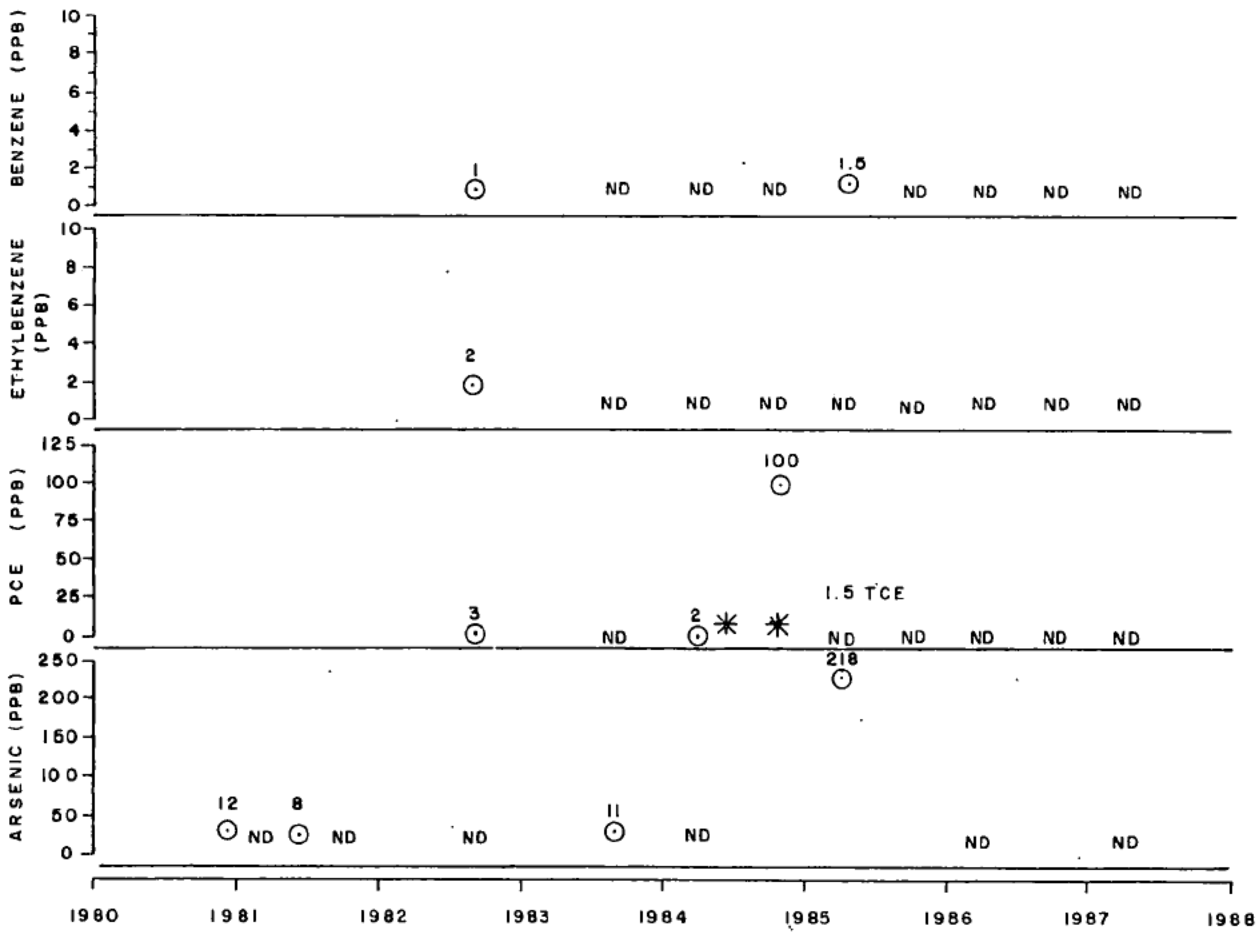


NOTES:

1. ND - NOT DETECTED (LIMIT OF ANALYTICAL DETECTION)
2. FOR SEPT., 1984 ANALYSES, VOC'S ARE REPORTED AS PPM IN REF # 16 OF NUS REPORT, AS PPB IN DUFFIELD REPORT
3. ✳ = TCE NOT DETECTED
4. ⨀ = DETECTED CONCENTRATION

cabe
128-5
JUNE, 1987
128A-004

MONITOR WELL 28
PIGEON POINT LANDFILL



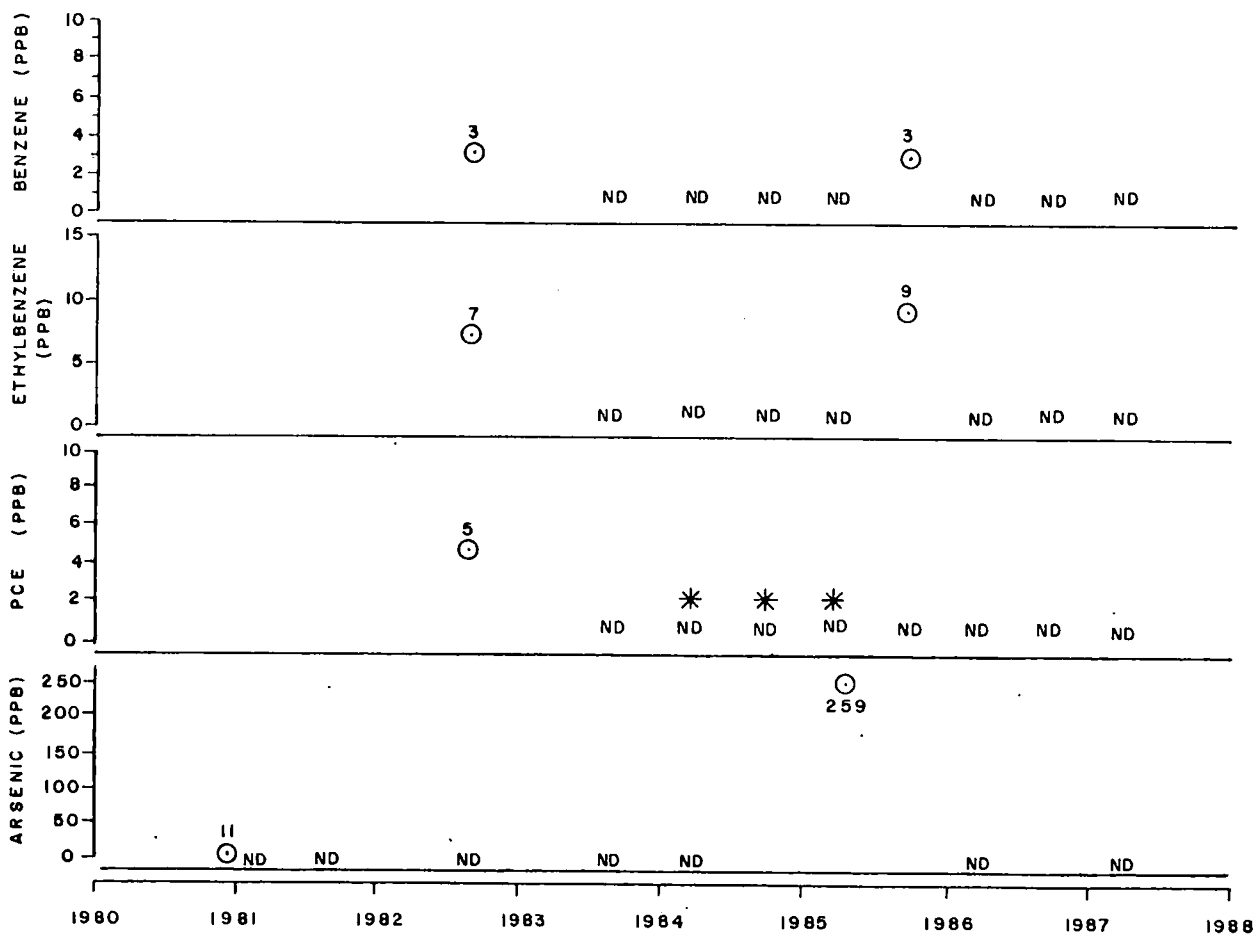
NOTES:
1. ND - NOT DETECTED (LIMIT OF ANALYTICAL DETECTION)
2. ✳ = TCE NOT DETECTED
3. ⊙ (3) = DETECTED CONCENTRATION

EXHIBIT III - 5

128-5
JUNE, 1987
128A-005

MONITOR WELL 29
PIGEON POINT LANDFILL

EXHIBIT III-6



NOTES:
1. ND - NOT DETECTED (LIMIT OF ANALYTICAL DETECTION)
2. ✳ = TCE NOT DETECTED
3. ⊙ = DETECTED CONCENTRATION

TREATMENT ALTERNATIVES

CHAPTER IV

IV. TREATMENT ALTERNATIVES

The evaluation of treatment requirements as presented in the previous chapter of this report indicates that treatment may not be necessary because: (1) evidence indicates that a release from the landfill did not occur, (2) even maximum expected treatment system contaminant concentration levels are well below advisory or regulatory levels, and (3) the effects of treatment may not be measurable. Nevertheless, for informative purposes the alternatives available for treatment of contaminants alleged to have been found in the recovered site groundwater are discussed below. Expected treatment system effluent concentrations are given and implementation briefly discussed. Also, the need for implementation of treatment is discussed as a "no action" alternative.

A. Action Alternatives

Excluding the application of granulated activated carbon treatment systems (GAC), different treatment approaches are generally required for removal of inorganic compounds (IOCs) as opposed to the removal of synthetic organic compounds (SOCs) from a recovered groundwater. The Environmental Protection Agency (EPA) has conducted treatability studies for the removal of synthetic organic compounds and metals such as arsenic as part of the process for setting maximum contaminant levels (MCLs) for drinking water. In addition, numerous treatability studies can be found in the literature. Viable treatment alternatives for SOC removal are very briefly summarized and discussed separately from viable treatment alternatives for the removal of arsenic in the remainder of this section.

1. Treatment Alternatives for Volatile Organics Removal

For removal of synthetic organic compounds (SOCs), of which volatile organic compounds (VOCs) are a subgroup, the Safe Drinking Water Act defines GAC treatment systems as best available treatment (BAT). BAT is defined as the most feasible treatment technique for obtaining established MCL's in drinking water considering such variables as performance under field conditions and treatment costs.

GAC systems can typically remove in excess of 99 percent of most VOC's, with vinyl chloride being one notable exception to this rule. Typically, two (2) carbon filled pressure vessels are operated in a series lead/lag relationship. When water samples taken from a tap located between the lead and lag vessels indicate "breakthrough" of a VOC (i.e. the presence of a VOC is detected) through the lead vessel, the lag vessel is placed first in-line, the lead vessel taken off-line, and the carbon in the previously lead vessel replaced. The spent carbon can be regenerated or landfilled. In either case, spent carbon may be classified as a hazardous waste under Resource Conservation and Recovery Act regulations, with strict notification, transportation and disposal requirements placed upon the spent carbon. Replacement of the spent carbon from the vessel is usually a considerable cost item in GAC installations.

Although GAC is defined as BAT by law, alternate treatment systems can be utilized if they are considered equivalent to GAC. Packed bed aeration, or air stripping as it is most commonly referred to, is also been accepted for use by the EPA as BAT for VOC removal[3]. The designation of air stripping as BAT was based primarily on air stripping's ability to achieve a high level (99 percent) of VOC removal under a variety of operating conditions, it's ease of installation, low maintenance requirements, and it's cost effectiveness. An air stripper installation typically consists of a tower, sump and pump. The tower is packed with media over which the VOC contaminated water flows as fresh air is forced upward through the tower. The media provides a large surface area for volatilization of VOCs to occur, and the VOC laden air is exhausted through the top of the tower. Treated water collects in a sump at the base of the tower and is pumped into the water delivery system.(4,5)

For treatment of recovered groundwaters consisting of a mixture of VOCs and IOCs and/or non-volatile SOCs, or for groundwaters with very high concentrations of VOCs present, it is often most cost-efficient to combine GAC units with air stripping towers.(6,7,8) By first removing the vast majority of the VOCs in the air stripper tower, the life of the activated carbon in the GAC is vastly increased, the treatment costs are kept low, and highly reliable removal efficiencies are assured. GAC treatment systems are also often utilized to remove VOCs from the air stripper stack emissions, if required by air emissions regulations.

In general, selection of the most cost effective treatment technique requires consideration of such design parameters as VOC concentrations, site specific allowances, compliance with other Federal and State regulations covering waste generation and air emissions, etc.

2. Treatment Alternatives for Arsenic Removal

Arsenic is a metalloid found naturally in rocks and minerals. It also is found in industrial wastes, pesticides, mining tailings and as a byproduct from copper, gold and lead refining. In an aquaeous solution arsenic can be found in a number of oxidation states: +5, +3, 0, -3. Removal of arsenic from groundwaters is highly dependent upon in what oxidation state arsenic is found in the water and the pH of the water.

A number of coagulation/precipitation/sedimentation (CPS) treatment processes are suitable for the removal of arsenic from groundwaters. In one CPS system, an oxidant such as potassium permanganate or chlorine gas is added to ferric chloride salts to produce 90-95% arsenic removals in a contaminated groundwater(9). Such a CPS system consists of an aerator, mixer, sedimentation tank, and sand filters for filtering coagulated arsenic compounds which did not settle in the tanks.

Arsenic can be very effectively removed by activated alumina, provided it is found in the +5 oxidation state(10). Alumina is up to 10 times less effective for removal of As (III). Process steps for activated alumina include removal in the alumina column, column backwash, column regeneration, rinse and neutralization. Neutralization is required as arsenic removal in a alumina column is a pH dependent process. Arsenic removals utilizing alumina column process can vary up to 90%

Other treatment processes are available for arsenic removal, including reverse osmosis, ozonation and GAC(10) systems. Contaminant removal efficiencies can range up to 99% for these alternatives.

3. Expected Contaminate Removals and System Implementation for Action Alternatives

Assuming that treatment system influent contaminate concentrations would be as detailed in Chapter III of this report, the following expected effluent values could be achieved using the treatment methods outlined above:

CONTAMINANT	TREATMENT SYSTEM	PREDICTED REMOVAL EFFICIENCIES	INFLUENT CONC (PPB)	EFFLUENT CONC (PPB)	DRINKING WATER STANDARD (PPB)
Benzene	GAC/ Air Stripper	99%+	3.0	ND (<1.0)	0 (Promulgated MCLG)
Ethylbenzene	GAC/ Air Stripper	99%+	9	ND (<1.0)	3400 (Provisional ADI)
Tetrachloro-ethylene	GAC/ Air Stripper	99%+	9	ND (<1.0)	20 (Health Advisory)
Arsenic	GAC	21-99	12	9-ND2.6	50 (Promulgated MCL)
	Reverse Osmosis	79-99	12	ND	50 (Promulgated MCL)
	Coagulation/ precipitation/ sedimentation	69-99	12	ND	50 (Promulgated MCL)

The ease of implementation and cost of implementation can not be estimated for any proposed treatment system unless the need for such a system and the particulars of the treatment requirements are fully established. Specifically, it is normally required to establish the type of recovery system that would be needed to intercept and prevent migration of the material from the suspect area. Once the need is established and these other studies are completed, water flow rates, anticipated influent contaminant concentrations and other treatment design parameters can be set and treatment system costs can be accurately established.

B. "No-Action" Alternative

Analysis of the existing water quality data suggests that the "no-action alternative" (i.e. continued monitoring) is the appropriate treatment alternative to pursue. As discussed previously in the text of this report, the monitoring well data utilized to provide the basis of recommendation for NPL listing has no continuity. The existing groundwater quality data also fails to establish the Pigeon Point Landfill as a source of aquifer contamination.

As pointed out previously, expected treatment system influent concentrations are well below advisory and regulatory drinking water quality requirements and approach the limit of analytical detection for the contaminants. It clearly would be unfounded to require what would amount to a costly and unnecessary treatment of an aquifer.

The use of major resources for groundwater treatment in the vicinity of the site chosen seemingly at random for treatment also runs counter to the importance given to cost of alternatives as expressed in EPA's December 24, 1986 Interim Guidance on Superfund Selection of Remedy. It would appear that a "no-action" treatment alternative is appropriate in this case.

Continued sampling of the wells should be carried out to reconfirm that the past 18 months of "no indicated contamination" is indicative of the actual status of groundwater quality in the area.

REFERENCES

1. NSWF - 1; "Pigeon Pont Landfill Monitoring Summary", prepared by Duffield Associates, Inc., Wilmington, Delaware, April 2, 1987.

2. "A Hazard Ranking System for Pigeon Point Landfill", prepared by NUS Corporation for USEPA under contract #68-01-6699.

3. Federal Register, "Proposed Rules for National Primary Drinking Water Regulations; Volatile Synthetic Organic Chemicals", Volume 50, Number 219, Wednesday, November 13, 1985.

4. Crittenden, Gehin, Hand and Lykins, "Design and Evaluation of an Air-Stripping Tower for Removing VOC's from Groundwater", Journal American Water Works Association, September 1986, p. 87-97.

5. Cummins and Wallman, "Design Scale-Up Suitability for Air-Stripping Columns", Journal Public Works, October 1986, p. 74-78.

6. Dyksen and McKinnon, "Removing Organics from Groundwater through Aeration Plus GAC", Journal American Water Works Association, May 1984, p. 42-47.

7. German, Hatch, McIntyre and Peschman, "Design and Performance of a Groundwater Treatment System for Toxic Organics Removal", Journal Water Pollution Control Federation, Volume 58, No. 1, January 1986, p. 41-46.

8. Gupta and Stenzel, "Treatment of Contaminated Groundwaters with Granular Activated Carbon and Air Stripping", Journal Air Pollution Control Association, Volume 35, No. 12, December 1985, p. 1304-1309.

9. Chemistry of Water Treatment, Faust and Aly, Butterworth Publishers, 1983.

10. Treatability Manual, EPA Document Number 600/8-80-042 A through C, July, 1980.

11. Code of Federal Regulations, Title 40, Chapter I, Parts 141.23 and 141.24.

ATTACHMENT 7

M E M O R A N D U M

TO: File DATE: June 21, 1977

FROM: "non responsive based on revised scope" [redacted]

SUBJECT: Investigation of the hydrologic connection between a contaminated zone at Pigeon Point landfill and a well belonging to ICI United States, Inc.

BACKGROUND

This memo is to document and summarize my investigation into the potential for contamination of the wells of ICI United States by leachate from the Pigeon Point landfill. Tracing individual sand units from well logs appeared very difficult because of the discontinuous nature of the fluvial sediments in the area. Also, we recognized that two sands laterally adjacent, even though they may not be the same sand, may be hydrologically connected. Therefore, we decided that the best way to determine if the ICI wells were connected with the contaminated zones at Pigeon Point was to see if the water level in a well at Pigeon Point responded to pumpage of the ICI wells.

MONITORING OF WATER LEVELS IN PIGEON POINT WELL 28

We chose to monitor the water level in Pigeon Point well #28 because it was between ICI and the landfill, it was screened in what Glenn Elliott of Richardson Assoc. called the "lower sand", and it was said that the sand it was screened in was relatively clean so that it should respond to water level changes in the aquifer.

Four weeks of continuous water level measurements were collected as shown on the attached charts. I informed [redacted] Sanitary Engineer for ICI, what we were doing and asked him for records of when their wells went on and off so that I could see if water level changes at the landfill seemed to correlate with the times that ICI pumps turned on or off. If so, it would appear that the landfill and the ICI wells are hydrologically connected with the zone screened in the ICI well(s). The pumping data Mr. [redacted] supplied me is attached. Although the landfill well's water level did respond to tidal fluctuations, it did not respond to ICI's wells going on and off. However, there were several difficulties. First, there were several times when the water level change did not appear to be due to tides but ICI did not have any pumping records for any of those times. Also, the pumping records showed that, except for the pumps that ran continuously, the pumps that came on usually were not on for more than an hour and often less than that. Therefore, the short pumping times would probably not be long enough to cause a change in water level over the relatively long distance to the landfill.

Due to these problems, I then wrote a letter to Mr. [redacted] Sanitary Group Supervisor for ICI, telling him that we would like to run a pump test in cooperation with ICI to pump one of the shallow production wells for at least 24 hours and to observe water level changes in well 28 at Pigeon Point landfill. [redacted] responded for Mr. [redacted] that they were going to have a maintenance shutdown at the plant and would like to arrange the test. With [redacted] help, the test was arranged and ICI well 11 was pumped at 500 gpm for 46 hours. ICI well 8 was used as an observation well as well as Pigeon Point well 28.

RESULTS

A good drawdown curve was obtained at well 8. From it, the transmissivity was calculated to be 38,200 gpd/ft and the storage coefficient is .00028.

From the transmissivity, storage coefficient, and distance from the pumping well, I calculated that the drawdown in well 28 should have been 4.12 feet at the end of the pump test, if both wells were in the same hydrologic unit. Since the water level declined only 0.135 feet after the pumping started, this indicated that the screened intervals of wells 11 and 28 are not well connected.

The well 28 water level recorder chart shows a series of water level fluctuations, both cyclical tidal fluctuations and some other fluctuations. I have plotted the elevations of the tides with time over the water levels with time. There is a definite correlation between each high and low tide but there seems to be no correlation, such as abnormally high or low tides, to explain the water level fluctuations other than the twice-a-day tides. There was a water level decline about 12 to 14 hours after well 11 began pumping. However, the water level began to rise before the pump was shut off. Beginning about 6 hours after the pump was shut off, there was a water level rise, but the water levels dropped and rose in a similar way from the 24th through the 27th when no pump test was being run. I began to suspect that the water level decline and recovery was not due to the pump test but was due to something else. When I plotted the mean daily barometric pressures for the time of interest, a pattern emerged (see the recorder chart). When the barometric pressure dropped and rose, the water level in well 28 rose and fell, respectively. The barometric efficiency was calculated from the ratio of the water level change in the well to the tidal level changes. Using this BE, the change in water level that should be due to atmospheric pressure was calculated. The water level dropped 0.135 feet after pumping began. The water level drop due to the barometric pressure change was calculated to be 0.12 feet. Therefore, it appears that essentially all the water level decline (and recovery) was due to atmospheric pressure changes and not due to drawdown caused by pumping ICI well 11. The same calculation done for well 28 water level and barometric data from 4-22-76 to 4-30-76 confirmed that a water level fluctuation was entirely due to atmospheric pressure change.

CONCLUSIONS

The conclusions of this work are that ICI well 11 does not appear to be hydrologically connected to the contaminated zone screened in Pigeon Point well 28. However, this does not necessarily mean that there is no potential for the landfill to contaminate ICI's wells. Since well 28 is about 50 feet deep and well 11 is about 100 feet deep, well 11 may be hydrologically connected to a deeper zone beneath the landfill. If that deeper zone is contaminated by the landfill, then there could be a potential to contaminate the ICI shallow wells. However, at the present time we do not know if the landfill contamination extends deeper than 50 feet or if any deeper zones beneath the landfill are hydrologically connected to ICI's wells.

If ICI drills a well adjacent to the landfill into the lower Potomac aquifer, we should use that well as an opportunity to learn something about the deeper sediments under the landfill.

/jm

ATTACHMENT 8

RECEIVED
3
MAR 12 1981
WATER SUPPLY

MEMORANDUM

March 10, 1981

TO : [redacted]

THRU: Michael A. Apgar MAA

FROM: Lisa A. Hamilton LAH

RE : Pigeon Point Landfill and ICI wells

In June 1977, Ron Stoufer conducted an "investigation of the hydrologic connection between a contaminated zone at the Pigeon Point Landfill and a well belonging to ICI United States, Inc.". In this investigation, Ron found that well 28 at the Pigeon Point Landfill (a Potomac well, 50 ft. deep; contaminated with Pb in an Open Dump Inventory sample) was most likely not hydrologically connected with ICI's well 11 (a Potomac well, 100 ft. deep). Ron's memo is attached.

Since that time, more wells have been installed at the Pigeon Point Landfill. The deepest new well, 41A, was found to be contaminated with Pb in an Open Dump Inventory sample. Well 41A is approximately 55 ft. deep. We could do an investigation similar to Ron's to determine if well 41A is hydrologically connected with ICI's well 11. However, chances are that the results would be the same (wells not hydrologically connected) since well 28 and well 41A are of similar depths, are in the same formation and are about 800 ft. apart.

Another alternative is to sample ICI's wells and run a heavy metals series on the samples. Since all of ICI's wells are deeper than the wells at Pigeon Point, it would be difficult to determine if any metals found in ICI's wells actually came from contamination caused by the landfill. Another problem we may encounter is the possibility of ground water contaminated by disposal practices at duPont's Chambers Works, being drawn under the Delaware River and into ICI's wells.

Deeper wells are needed at the Pigeon Point landfill to fully investigate the potential for contamination of ICI's wells by the landfill.

[redacted]

/tj

Att [redacted]
cc:

I agree with both Ron & Lisa's conclusions that while the existing Pigeon Pt monitoring wells are not in contact with the ICI production well zone, the LF could contaminate the ICI wells if the leachate moves deeper. — deeper monitor wells at the LF are the only way to answer this matter

MAA 3/12/81

ATTACHMENT 9

DE-27

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION III

841 Chestnut Building
Philadelphia, Pennsylvania 19107

SUBJECT: Pigeon Point Landfill HRS, F3-8506-14

DATE: SEP 10 1985

FROM: Laura Boornazian, SIO *Laura A. Boornazian*
Site Investigation & Support (3HW23)

TO: [redacted] FIT RPO
Site Investigation & Support (3HW23)

My TDD request for the Pigeon Point Landfill HRS was specific in stating: "State files on this site are extensive - will need to visit the DNREC office to gather information necessary to document the HRS score." I was surprised to find out from Steve McMahon that he did not review the state files, making the judgement that the information contained in the EPA file was sufficient to score the site. Since the draft HRS does not support an observed release to groundwater, I cannot accept this reasoning, and am therefore returning the package.

I have reason to believe that Delaware files do contain groundwater monitoring data which show contamination to be site related. I therefore, again request that state files be reviewed and this critical information be included in the HRS documentation.

In addition I recently received information from the Delaware Solid Waste Authority regarding the Pigeon Point Landfill. NUS should review this information and include it with the EPA file in their custody.

ATTACHMENT 10

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
841 Chestnut Building
Philadelphia, Pennsylvania 19107

SUBJECT: Request Assistance from FIT Office

DATE: 2/10/86

FROM: Laura A. Boornazian, Environmental Scientist
Site Investigation & Support Section (3HW23)

TO: [redacted] FIT Regional Project Officer
Site Investigation and Support Section (3HW23)

I. SITE NAME: Pigeon Point Landfill (DE-27)

II. LOCATION: New Castle, Delaware

III. WORK ASSIGNMENT:

- ____ Preliminary Assessment
- ____ Site Inspection
- _✓_ Hazard Ranking System
- ____ Toxicology Assessment
- ____ Enforcement Support
- ____ Quality Assurance Review of Data
- ____ Re-Sampling/Full Field Investigation
- _✓_ Peer Review Corrections/Finalize
- ____ Field Trip Summary Report
- ____ Target Population Study
- ____ Other

IV. PRIORITY:

_✓_ High (*) ____ Medium ____ Low

V. Preferred Deadline:

Date: ASAP - Feb. 27

VI. EXPLANATION OF TASK (* To include justification for high priority):

Finalize in accordance with attached comments.

VII. To be completed by FIT RPO only:

Task complete date by FIT:.................

Hours allocated:..................

Pigeon Point Landfill HRS
Peer Review
Laura Boornazian 2/10/86

This HRS was supposed to be resubmitted in draft form. Peer review comments were never submitted by EPA on the first draft.

General description of facility: need better history of site. I've sent some guidelines to NUS in the past for other HRSs (ask Gil Marshall). Discuss closure status.

GROUNDWATER ROUTE

Rationale

line 4--implies that all the above contaminants have migrated into the Potomac. Is this what was meant?
line 10--should this be 46 to 49?
last line of first para., results of sampling on well 29 not shown in SDS.
para. 2, prefer to delete since it contains some speculation.
3rd para., last sentence, cite reference for this statement following the statement.
Sample data summary in Ref. 19--prefer that arsenic be shown in same units (ug/l)

Description of aquifer

para. 2, line 6, should overlain be underlain?
last sentence, cite page nos. from Ref. 5 that support this.
para. 3, last sentence, cite a specific reference here.
Ref. 17, can't read the small lettering
Ref. 9--before we can use this, what distance is Halby from Pigeon Point. Add this information to the telecon note.
Tox/persistence--I think we should use only those compounds found in wells, since samples taken from leachate collection system could be considered contained.
Ref. 16--whose sampling is this? Clarify in list of Refs.

Quantity

Did you contact DSWA? This should be done.
Add to last line "The quantity of waste dumped, however, is unknown."

Basis of estimating quantity

line 1, change waste to "substances"

Groundwater Use

line 5, correct spelling of Lakshman
Artesian has a hookup with Wilmington Suburban (see Halby HRS). This serves as an alternate supply. You should research use of wells with no alternate supply in the area of concern.

Distance to nearest well

I gave you info. for your file on ICI which documents that ICI does use their well water for drinking supply. This should be used as the nearest well. This should have been researched by the preparer of this report.

Population served

line 2--reword to clarify that it's a common distribution system (water does not actually go to a central mixing point).
last line, delete "spike"

Computation of land area irrigated

This has to be researched and referenced like everything else.

SURFACE WATER ROUTE

Ave. slope of facility

Clarify if these are surface elevations?
Under name/desc. of nearest ds. surface water, prefer that you use Ref. 7 (easier to find).

Ave. slope of terrain

Is well 29A contaminated? Do we have to measure from a contaminated well?

Specify page no. of ref. 10 (make sure map shows location of well 29A also).

Is facility in surface water

Add Ref. 7

Is facility surrounded

Add Ref. 7

Physical state of waste

GW section did not evaluate physical state of waste, so you have to do it here.

Method of waste containment

References don't really support in detail. I sent over some info. from DSWA on their leachate control methods. This would have been a better reference.

I recommend reevaluating this. They apply a daily cover, have a dike around the site, and leachate is no longer permitted to flow into the Del. River since construction of the leachate collection system. How can you say "no diversion structure?"

Use of surface water

Christina River--where's this in relation to site? Did you mean Magazine Creek? or just Delaware River?

Is there tidal influence?

cite page no. in Ref. 10 or use Ref. 7

Distance to wetland

Calculations are not clear. Define terms.

Distance to critical habitat

N/A not an appropriate response. Explain.

Computation of land area irrigated

This should be researched and referenced.

AIR ROUTE

line 3, what's the wet well?
Reference?

FIRE & EXPLOSION

Should cite ref. 12 (not 13)

DIRECT CONTACT

Containment

How can you document that haz. substances are accessible to direct contact?

REFERENCE LIST

Ref. 6--correct spelling of Lakshman
Ref. 8--line 3, Engineers

ATTACHMENT 11

LIST OF NAMES AND PHONE NUMBERS OF PEOPLE INTERVIEWED RE: BRANDT LABS

I. BRANDT LABS

"non responsive based on revised scope" [redacted]

(215) 253-3202
258-9135(ext.203)

(215) 826-3814

(215) 252-2279
861-0291

(803) 359-9125

(215) 868-9997
747-1893

(302) 834-1463
453-6920

(215) 258-2911

(201) 222-2086

II. OTHER

"non responsive based on revised scope" [redacted] Georgia Gulf Corp. (302) 836-2144

ATTACHMENT 12

METHOD OF STANDARD ADDITIONS

ATE: 5-2-85 TECHNICIAN: DE SHEET 1 OF 2

AMPLE VOLUME: ______ STANDARD VOLUME 265 TOTAL VOLUME: _____

TANDARD CURVES CONCENTRATION	TEST # ARSENIC RESP	CALC	% R	TEST # 270 Se RESP	CALC	% R
BLANK						
SLOPE						

OG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393 081 110	101.181 → 25 0.247	A B C D				5	0.005	0.001
		SLOPE						
		EXTRAPOLATION	0		.218	0		<.002
393 081 111	100.24 → 25 0.249	A B C D				4	0.004	0.001
		SLOPE						<.002
		EXTRAPOLATION	0		259	0		
393 081 112	100.185 → 25 0.250	A B C D				4	0 004	0.001
		SLOPE						
		EXTRAPOLATION	0		.213	0		<.002
393 081 113	101.511 → 25 0.246	A B C D				2	0.0007	0.0002
								<.002
		SLOPE						
		EXTRAPOLATION	0		.171	0		

COMMENTS/NOTES.
393
081 spike
112
1 ml 2.5 ppm

60 0.083 $\frac{0.083}{0.1}$ = 83%

CH ______ LAB DIR ______ DATA ENT [illegible] 5.15.85

A T T A C H M E N T 13

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE VTS SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 RESP	CALC	% R	TEST # 270 RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

LOG #	Antimony initial DILUT.	Antimony final CONC. OF STD		RESP	CALC		RESP	CALC	% RESULT
73 078-107	100,292 D.F. = 0.249	25 ml	A / B / C / D	15	0.44 − 0.1 = 0.34; $\frac{0.34 \times 2.5}{100,292} \div .55 = 0.016$	< 0.025	8; curve 112	2.0×10^{-3}; .002	~~0.0005~~ < 0,002
			SLOPE						
			EXTRAPOLATION	0			0		
73-078-108	100,473 D.F. 0.249	25 ml	A / B / C / D	17	0.55 − 0.1; $\frac{0.45 \times 2.5}{100,473} \div 0.55 = 0.020$	< 0.025	10; curve 112	4.7×10^{-3}; .005	~~0.001~~ < 0.002
			SLOPE						
			EXTRAPOLATION	0			0		
73-078-109	99,331 D.F. = 0.252	25 ml	A / B / C / D	12	0.40 − 0.1; $\frac{0.30 \times 2.5}{99,331} \div 0.55 = 0.013$	< 0.025	2; curve 112	-6.1×10^{-3}; −0.006	~~−0.002~~ < 0.002
			SLOPE						
			EXTRAPOLATION				0		
73-078-110	102,348 D.F. = 0.244	25 ml	A / B / C / D	19	0.62 − 0.1; $\frac{0.52 \times 2.5}{102,348} \div 0.55 = 0,023$	0.025	4; curve 112	-3.4×10^{-3}; −0.003	~~−0.0007~~ < 0.002
			SLOPE						
			EXTRAPOLATION	0			0		

COMMENTS/NOTES

TECH VTS DE SUP ______ Q.C. ______ LAB DIR ______ DATA ENT

DATE 4-23-85

MB 4/25/85

4-25-85

ATTACHMENT 14

Delaware Solid Waste
% Parkowski, Noble and Guerke P.A.
PO Box 598
Dover, De. 19903

JUL 6 1987

June 25, 1987

Dear Gentlemen:

I was asked to write a short explaination of the two data sheets I was sent concerning the arsenic and selenium results for 4 23 85 and 5 2 85.

The test sheet for 4 23 85 contains results for Arsenic (test # 265) and Selenium (test # 270). I ran the Se on the samples and signed the sheet at the top of the page; I was not running As at that time. Although the Se is not in question, I'll briefly describe the calculations because it is my standard practice to record all the information needed in the event the results are questioned as in this case.

The sample number is in the left hand column along with the dilution factor used in prepping the sample. The middle column contains As information: the As test on the date (4 23 85) was performed by J. Thomas Balas who would be able to explain his own calculations more fully. The third column is for Se which I ran. The instrument responses (8, 10, 2, 4) are listed along with the Julian calander number (112) of the curve used to calculate the results. The curve would be found on top the first data sheet from that day's run (112). The concentrations are calculated by using the absorbences and the standard curve. The final concentration is arrived at by applying the blank and dilution factor to the initial concentration. The results were recorded by LSS (Louise S.Snyder) and Karl Brandt approved the results on 4 28 85.

Concerning the problem data sheet from 5 25 85. I performed the Se test (270) and signed the test sheet as before. I don't believe there is any problem here. The problem is with the As which I did not run. I think you can see the difference in handwriting and the apparent lack of information which I was in the habit of recording. I think you can also see that J. Thomas Balas did not perform the test as the results are not in keeping with his style either. I can only guess who may have run the As on this day since the test sheet was not signed by the As technician. I am sorry that I cannot shed more light on your problem.

I was also asked to describe the state of Brandt Associates at the time this occured. People began leaving in January of 1985 due to lack of funds to meet payroll. This included Richard Bleam who had been in charge of quality control and who was also very knowledgable in testing methods. As payrolls got further behind technicians began considering other employment opportunities and made plans to leave. Tests were often "handed down" to people with little experience in performing them and without proper instruction and supervision. I believe this is how the As problem arose. Generally, the Lab was in a state of chaos at that time and closed shortly thereafter.

I hope this information proves helpful in dealing with your problem. Please contact me if I can be of any further assistance.

Sincerely,

"non responsive based on revised scope"
[redacted]

"non responsive based on revised scope"
[redacted]

METHOD OF STANDARD ADDITIONS

DATE: 4-23-85 TECHNICIAN: DE VTOS SHEET ____ OF ____

SAMPLE VOLUME: ______ STANDARD VOLUME: ______ TOTAL VOLUME: ______

STANDARD CURVES CONCENTRATION	TEST # 265 RESP	CALC	% R	TEST # 270 RESP	CALC	% R
1) BLANK						
2)						
3)						
4)						
5)						
6)						
SLOPE						

LOG #	Astrum initial DILUT.	final CONC. OF STD		RESP	CALC	% R RESULT	RESP	CALC	% RESULT
73 078-107	100,292 D.F. = 0.249	25 ml	A B C D	15 $\frac{0.34\times2.5}{100,292}$	0.44 − 0.1 ÷ .55 = 0.018	< 0.025	8 curve 112	2.0×10^{-3} .002	~~0.0005~~ <0.002
		SLOPE							
		EXTRAPOLATION		0			0		
73-078-108	100,473 D.F. 0.249	25 ml	A B C D	17 $\frac{0.45\times2.5}{100,473}$	0.55 − 0.1 ÷ 0.55 = 0.020	<0.025	10 curve 112	4.7×10^{-3} .005	~~0.001~~ <0.002
		SLOPE							
		EXTRAPOLATION		0			0		
373-078-109	99,331 D.F. = 0.252	25 ml	A B C D	12 $\frac{0.30\times2.5}{99,331}$	0.40 − 0.1 ÷ 0.55 = 0.013	<0.025	2 curve 112	-6.1×10^{-3} −0.006	~~−0.002~~ <0.002
		SLOPE							
		EXTRAPOLATION					0		
373-078-110	102,348 D.F. = 0.244	25 ml	A B C D	19 $\frac{0.52\times2.5}{102.348}$	0.62 − 0.1 ÷ 0.55 = 0.023	0.025	4 curve 112	-3.4×10^{-3} −0.003	~~−0.0007~~ <0.002
		SLOPE							
		EXTRAPOLATION		0			0		

COMMENTS/NOTES:

TECH VTOS DE SUP ______ Q.C. ______ LAB DIR ______ DATA ENT [signature] 4-25-85

MB 4/25/85

METHOD OF STANDARD ADDITIONS

ATE: 5-2-85 TECHNICIAN: DE SHEET 1 OF 2

AMPLE VOLUME: ______ STANDARD VOLUME 265 TOTAL VOLUME: _____

TANDARD CURVES CONCENTRATION	TEST # ARSENIC RESP	CALC	% R	TEST # 270 Se RESP	CALC	% R
BLANK						
SLOPE						

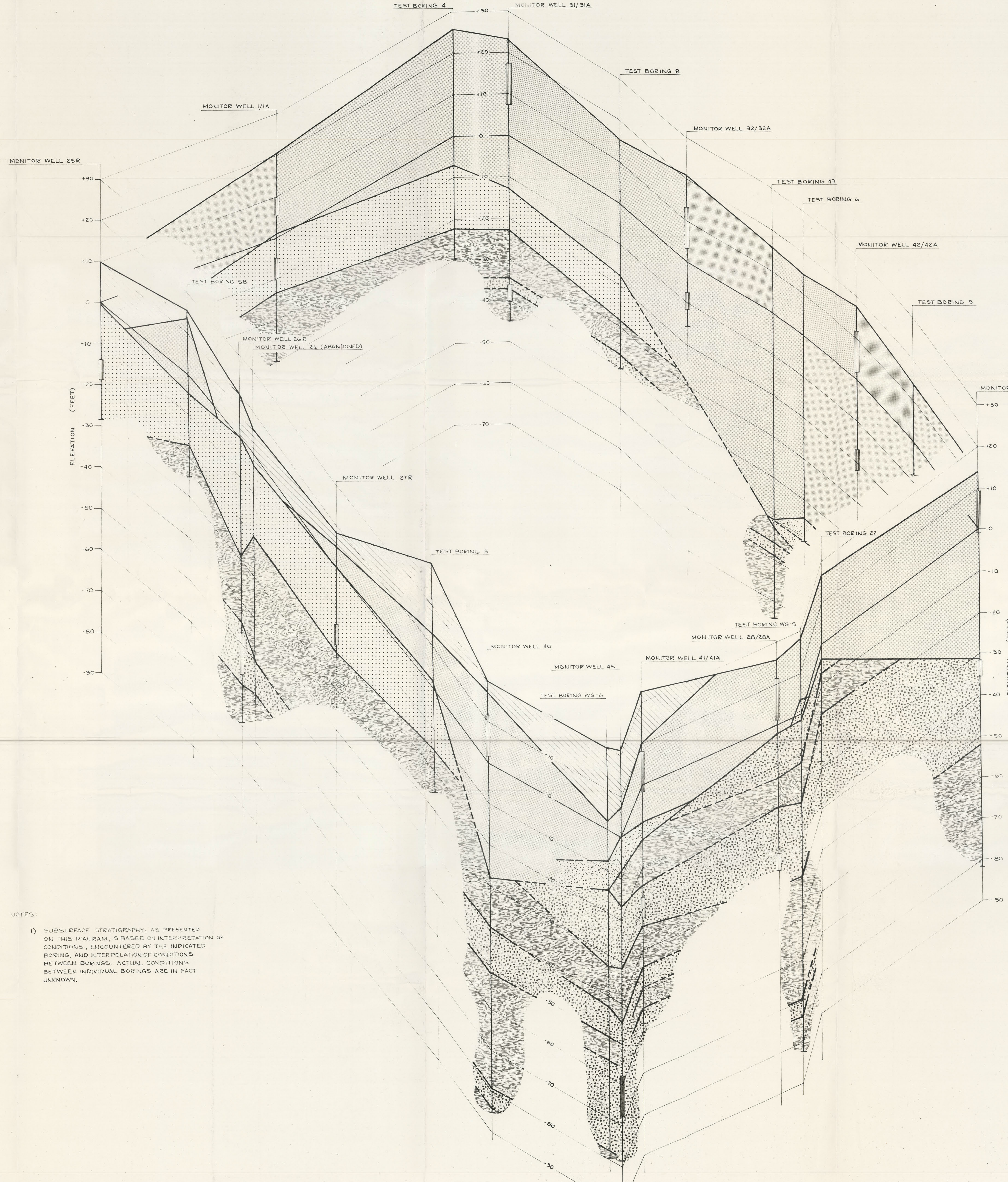
OG #	DILUT.	CONC. OF STD	RESP	CALC	% R RESULT	RESP	CALC	% R RESULT
393 081 110	101.181→25 0.247	A B C D		✓		5	0.005	0.001
		SLOPE						
		EXTRAPOLATION	0		.218	0		<.002
393 081 111	100.214→25 .219	A B C D				4	0.004	0.001
		SLOPE						<.002
		EXTRAPOLATION	0		.259	0		
393 081 112	100.185→25 0.250	A B C D				4	0.004	0.001
		SLOPE						
		EXTRAPOLATION	0		.213	0		<.002
393 081 113	101.511→25 0.246	A B C D				2	0.0007	0.0002
								<.002
		SLOPE						
		EXTRAPOLATION	0		.171	0		

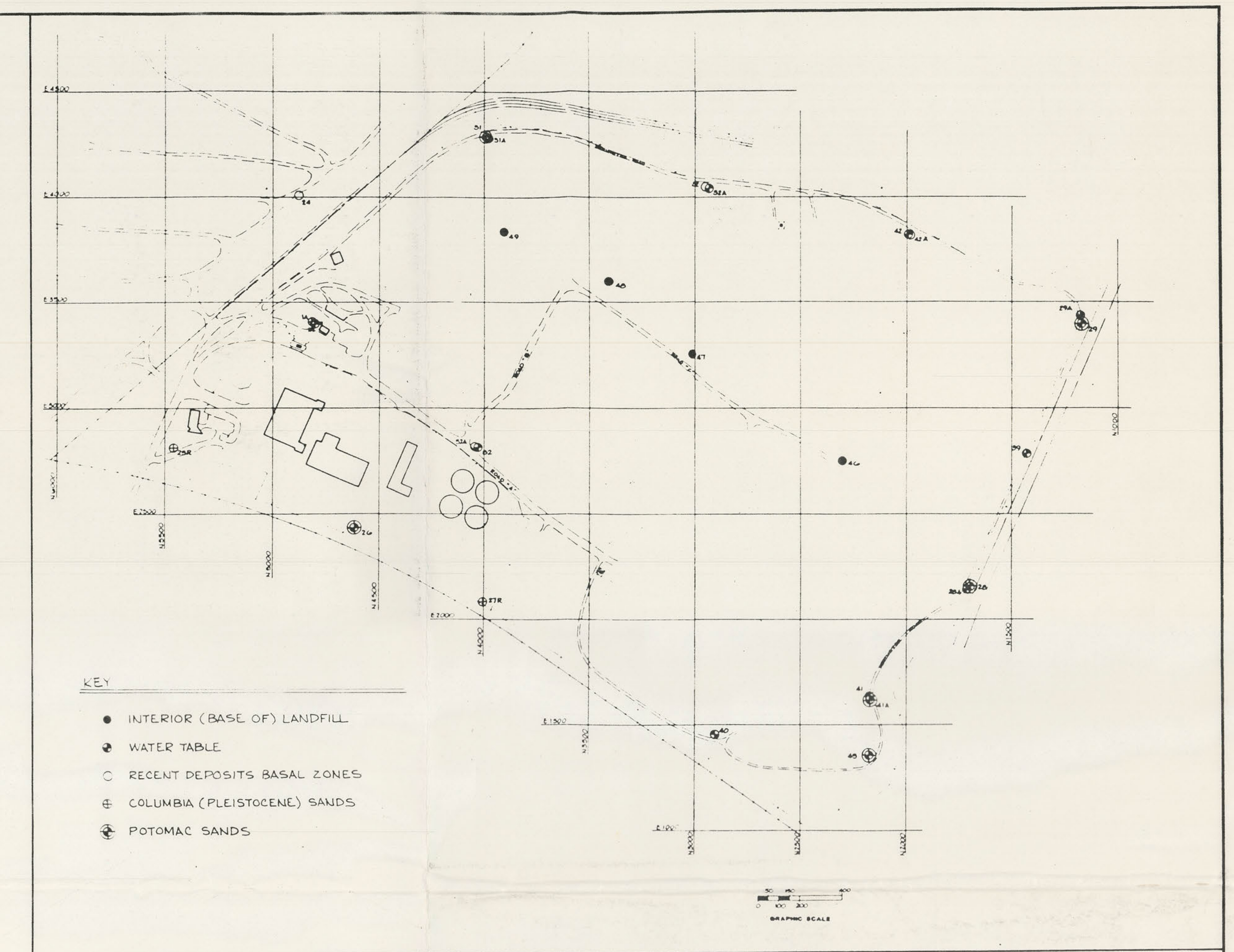
393
OMMENTS/NOTES:
081 spike
113
1ml 2.5 ppm

60 0.083 $\frac{0.083}{0.1}$ = 83%

CH ______ Q.C. ______ LAB DIR ______ DATA ENT ______ 5.15.8

1 03/07/81





INDEX SKETCH

NOTES:

1.) SUBSURFACE STRATIGRAPHY, AS PRESENTED ON THIS DIAGRAM, IS BASED ON INTERPRETATION OF CONDITIONS, ENCOUNTERED BY THE INDICATED BORING, AND INTERPOLATION OF CONDITIONS BETWEEN BORINGS. ACTUAL CONDITIONS BETWEEN INDIVIDUAL BORINGS ARE IN FACT UNKNOWN.

LEGEND & STRATUM KEY

HORIZONTAL 0 100 200 400 600 800 GRAPHIC SCALE

STRATUM	KEY	TYPICAL DESCRIPTION
		MISCELLANEOUS FILL (SAND, SILT, & CLAY; MAY CONTAIN REFUSE IN UPPER ZONE)
RECENT DEPOSITS		"FINE GRAINED" SEDIMENTS (HYDRAULIC DREDGE SPOIL, MARSH & RIVER BOTTOM SEDIMENTS) WITH IRREGULAR "CHANNEL" SAND & GRAVEL DEPOSITS AT BASE
COLUMBIA (PLEISTOCENE) FORMATION		GRAVELLY, FINE TO MEDIUM SANDS WITH SOME INTERBEDDED SILTS AND CLAYS
POTOMAC FORMATION		VARIEGATED, FREQUENTLY LIGNITIC, SILTS & CLAYS WITH IRREGULARLY INTERBEDDED SANDS AND SOME GRAVEL
		STRATIGRAPHIC TEST BORING
		OBSERVATION WELL BORING (WITH WELL SCREEN INTERVAL)

PLATE I

STRATIGRAPHIC FENSE DIAGRAM

NSWF-1

DELAWARE SOLID WASTE AUTHORITY

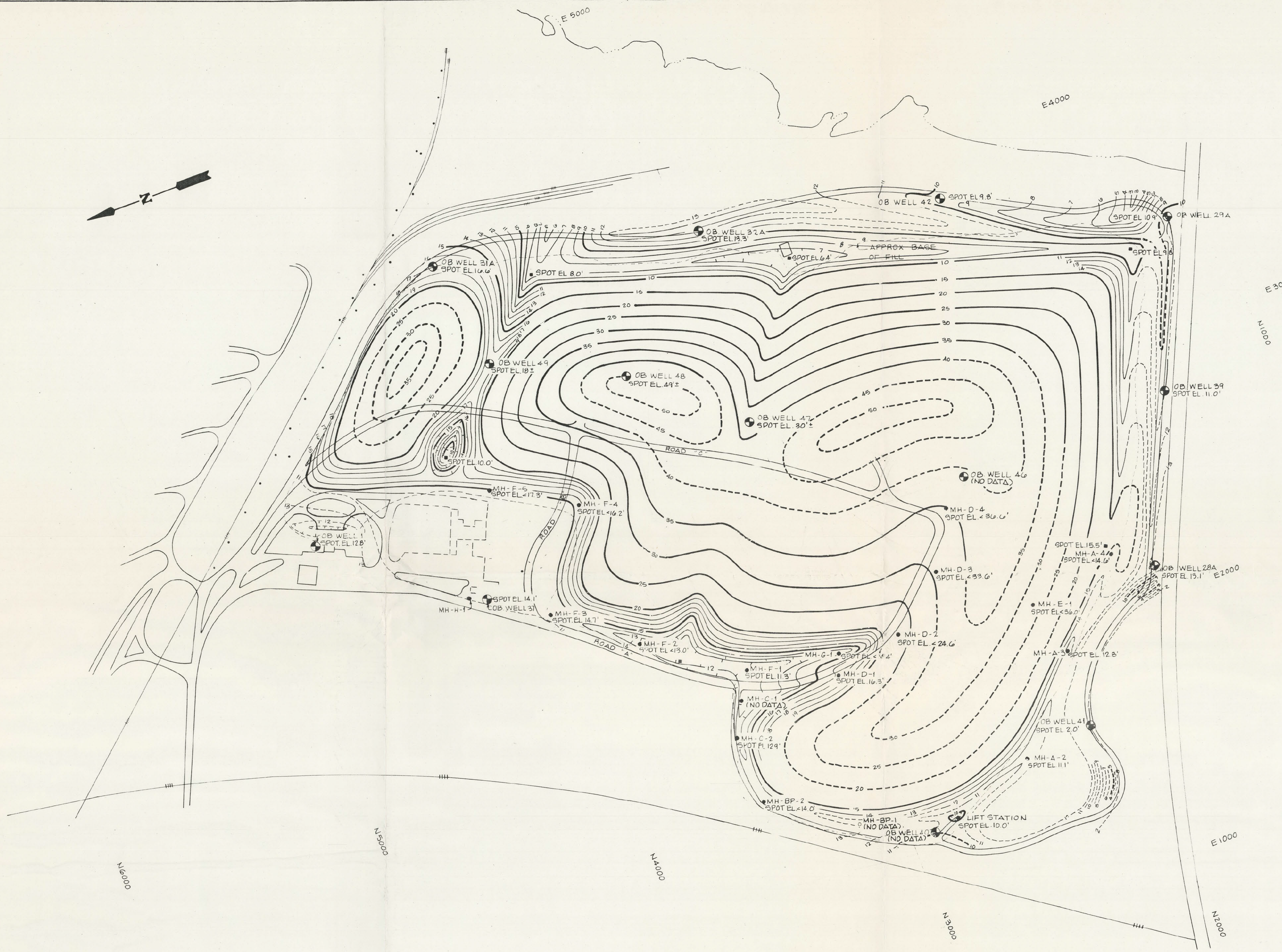
No.	REVISION	CHK'D BY DATE

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
WILMINGTON, DELAWARE

APPROVED BY

DESIGNED BY		DATE	02 APRIL 1987
DRAWN BY	DHP	SCALE	HORIZONTAL 1" = 200' VERTICAL 1" = 10'
CHECKED BY	GKE	W.O. NO.	260HU
DRAWING NO.	D-260HU-1	SHEET NO.	1 OF 1

NPL-U6-3-L21-R3



KEY:

- WATER-TABLE OBSERVATION WELL
- • MANHOLE (WEST SIDE LEACHATE COLLECTION SYSTEM)
- ▪ MANHOLE (EAST SIDE LEACHATE COLLECTION SYSTEM)
- —15— INTERPOLATED WATER LEVEL ELEVATION
- --15-- PROJECTED WATER LEVEL ELEVATION

NOTES:

1. ELEVATIONS SHOWN IN MANHOLES (M.H.) AND OBSERVATION WELLS ARE BASED ON FIELD SURVEYS CONDUCTED BETWEEN 26 JANUARY AND 29 JANUARY 1983.
2. SPOT EL. 36.6' – SPOT WATER LEVEL ELEVATION
   ± – WATER LEVEL DETERMINATION APPROXIMATE
   < – WATER LEVEL BELOW THE INDICATED MANHOLE INVERT ELEVATION

PLATE II

INTERPRETED WATER-TABLE AND LEACHATE MOUND CONFIGURATION JANUARY 1983

NSWF-1

DELAWARE SOLID WASTE AUTHORITY

No.	REVISION	CHK'D BY DATE

DUFFIELD ASSOCIATES, INC.
CONSULTING GEOTECHNICAL ENGINEERS
NEWARK DELAWARE

APPROVED BY

DESIGNED BY	[redacted]	DATE	FEB. 24, 1983
DRAWN BY		SCALE	1" = 200'
CHECKED BY		W.O. NO.	260-B
DRAWING NO.	C-260B-14	SHEET NO.	1 OF 1

NPL-U6-3-L21-R3